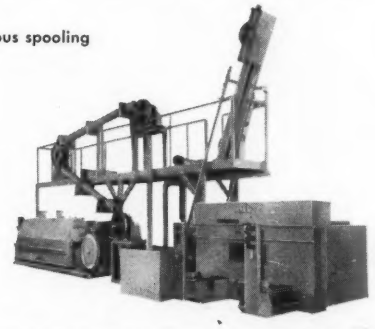
WIRE AND WIRE PRODUCTS

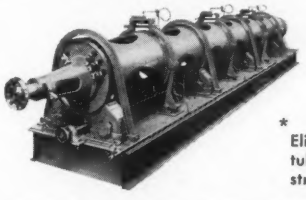
FEBRUARY 1956

A COMPLETE LINE OF QUALITY MACHINERY FOR THE WIRE INDUSTRY

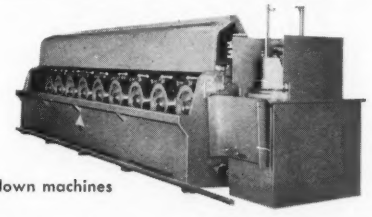
Combined drawing—annealing and continuous spooling



Constant tension payoff stands

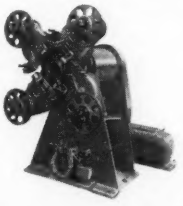


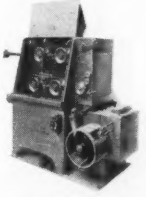
*Eliptube tubular stranders



Tandem rod breakdown machines

Cable taping machines





Coarse and fine wire drawing machines

*REGISTERED TRADENAME

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Better Machinery for the Wire Industry

SYNCRO MACHINE COMPANY
PERTH AMBOY, NEW JERSEY, U. S. A.
AFFILIATED COMPANY, WINGET-SYNCRO LTD. ROCHESTER, KENT, ENGLAND

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

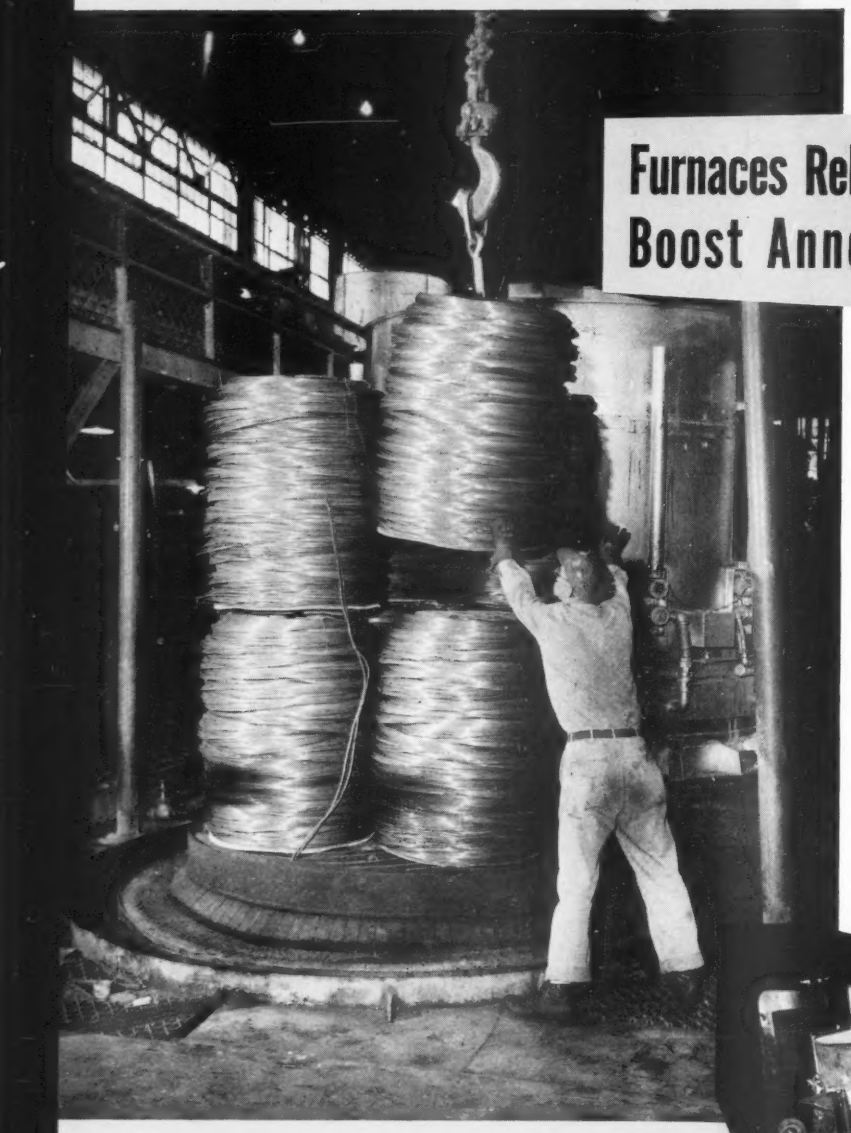
Furnaces Rebuilt for High Convection Boost Annealing Production by 75%

Northwestern Steel and Wire Co. finds the addition of Lee Wilson High Convection System plus "O" Tubes Pays Big Dividends.

Realizing the advantages of high convection annealing for wire coils, Northwestern Steel and Wire called in Lee Wilson engineers to look over their operation.

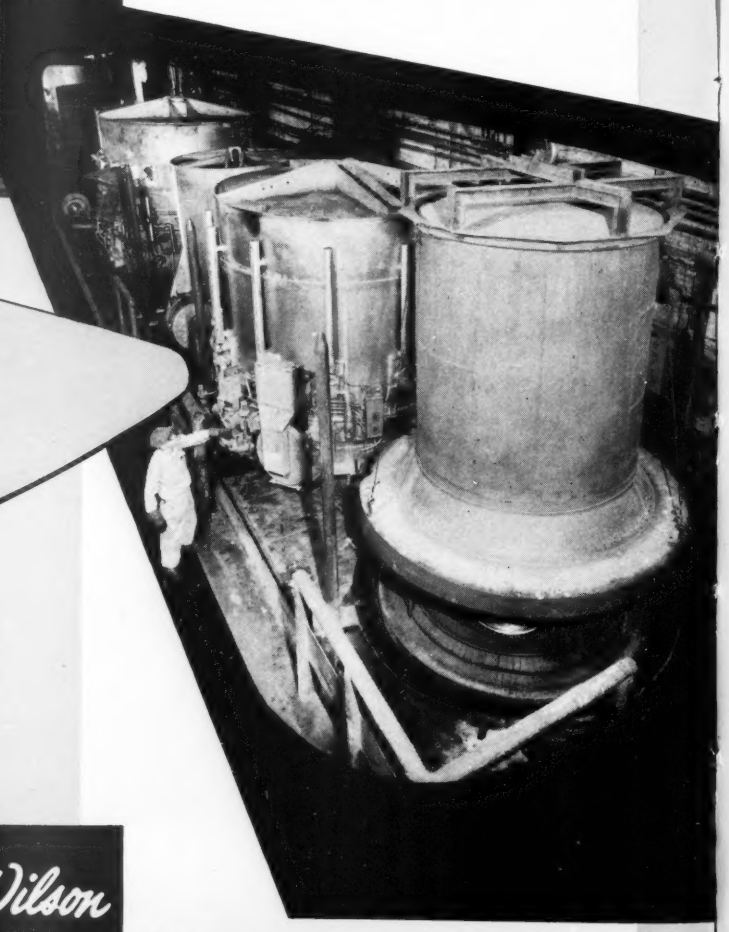
It was suggested that Northwestern convert their present bell type furnaces to high convection. "O" tubes were installed in the furnace to double the fuel input and the recirculating fan high convection units with 20 HP drives were installed in the bases. The result of this inexpensive operation was a tonnage boost from 2000 lbs. per hour to 3500 lbs. per hour.

Why not call in a Lee Wilson engineer to discuss rebuilding your equipment and gain the same advantages that Northwestern has realized? They're the nation's most experienced high convection people.



tting a charge on converted furace at Northwestern. Lee Wilson ngineers high convection units th fan drives from 7½ HP 25 HP with deliveries from 000 to 25,000 cfm.

View from underside of furnace showing how "O" tubes completely surround each charge. This type of radiant tube permits at least double the fuel input to any size furnace.



Lee Wilson

ENGINEERING COMPANY, Inc.

SERVICE

INTEGRITY

CONSISTENCY

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ORGANIZATION

equal

"America's Finest

Wire Drawing Lubricants"

Standard Industrial has pioneered in most of the outstanding contributions to better wire drawing through better lubricants. Consult Standard Industrial for the solution of your difficult problems.

Standard Industrial

COMPOUNDS CO., INC.

4600 WEST FERDINAND STREET

CHICAGO 44, ILLINOIS

TELEPHONES: Mansfield 6-9324-5-6

Voices under the sea

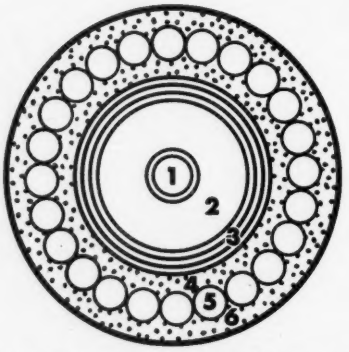
Late last summer *HMTS Monarch,* British cable ship, completed the ticklish job of laying the first of twin telephone cables some 2,250 miles across the Atlantic, from Newfoundland to Scotland. When the second cable is laid during the coming summer, it will mark the establishment of the first trans-Atlantic telephone system.

This joint venture of American, British and Canadian interests will make it possible for your voice to travel to Europe as clearly as in a telephone chat with a neighbor. The new cables will carry up to 36 conversations at the same time. Service is to be inaugurated by late 1956.

Major strength element of the new cables is a spiral wrapping of 24 steel armor wires, for which Simplex Wire and Cable Company, cable manufacturers, used a quantity of bethanized wire. Developed by Bethlehem, bethanized wire is electrolytically coated with pure zinc. The coating is uniform, highly ductile, and tightly bonded to the steel wire.

A number of underwater cables have been armored with bethanized wire. And that's just one of hundreds of uses for this unique wire. Capable of being severely formed, bethanized wire is available with light, medium, and heavy coatings which provide excellent corrosion-resistance.

We suggest you let us arrange a trial order. Our nearest sales office will gladly give you full details.



This drawing shows the structural features of the 1¼-in. diam type D cable used in deep water. 1—Copper center wire and surround tapes. 2—Polyethylene insulation. 3—Copper return tapes, teredo tape and telconax tape. 4—Jute bedding. 5—24 steel armor wires. 6—Two servings of jute. Heavier types of cable construction are used in shallow water.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
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BETHLEHEM WIRE

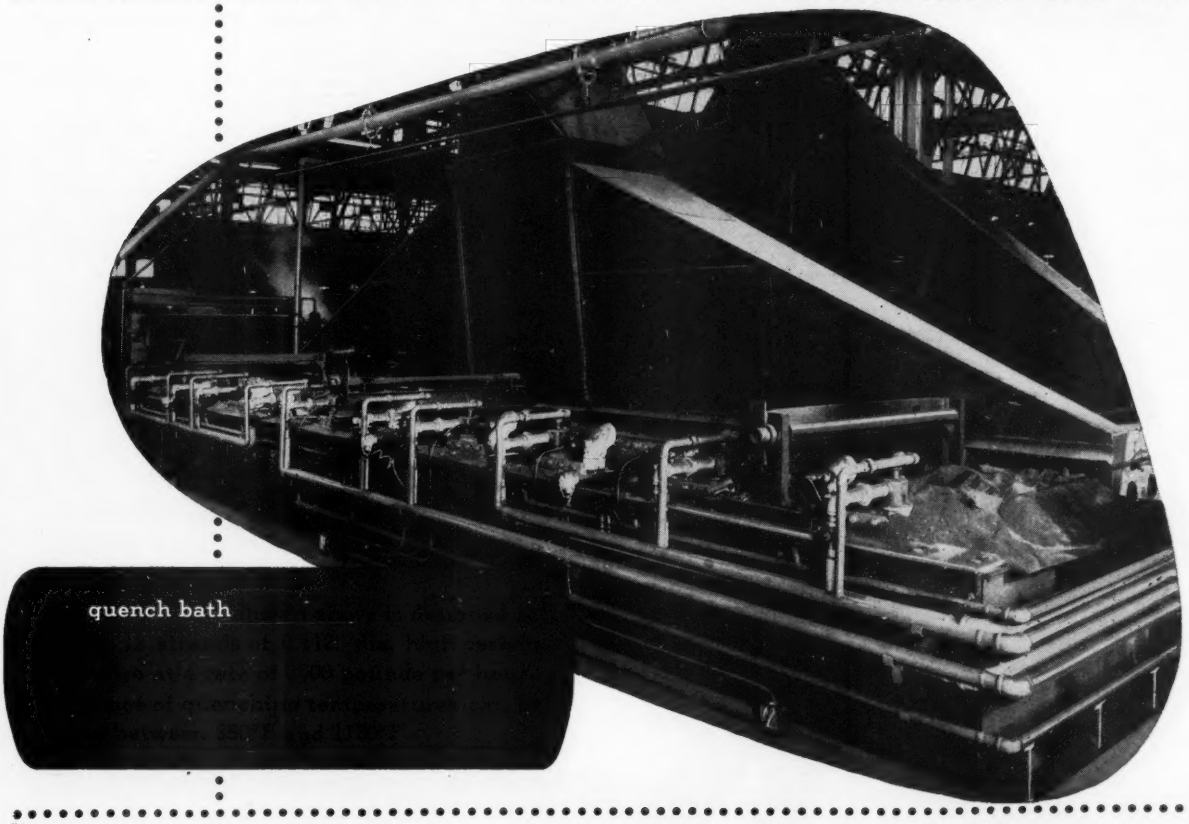
BETHLEHEM STEEL

DREVER

IMMERSION TUBE HEATED LEAD QUENCH FOR WIRE PATENTING

This 3-zone 30 ft. long gas-fired immersion tube heated lead quench forms part of a continuous patenting, cleaning and coating line for high carbon steel wires.

The multi-zoned lead quench is not only heated by gas-fired immersion tubes, but also utilizes the same immersion tubes with forced air cooling to maintain uniform temperatures throughout the bath. A specially designed control system automatically proportions the gas heating and/or air cooling of the tubes.



quench bath

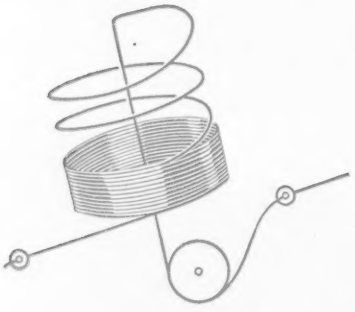
DREVER COMPANY

RED LION RD. and PHILMONT AVE., BETHAYRES, PA.

32

MORGAN-CONNOR

Cooling by AIR



If you want
High Speed Wire Drawing

You must have
High Efficiency Wire Cooling

The Morgan-Connor System of Air Cooling is proving its superiority in many mills.

Ask about it.

MORGAN CONSTRUCTION CO.
WORCESTER, MASS.

WM-85

WIRE AND WIRE PRODUCTS*

Reg. U. S. Pat. Off.

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 31 February, 1956 No. 2

Designated as Official Publication By The Wire Association

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Pressed Steel Division
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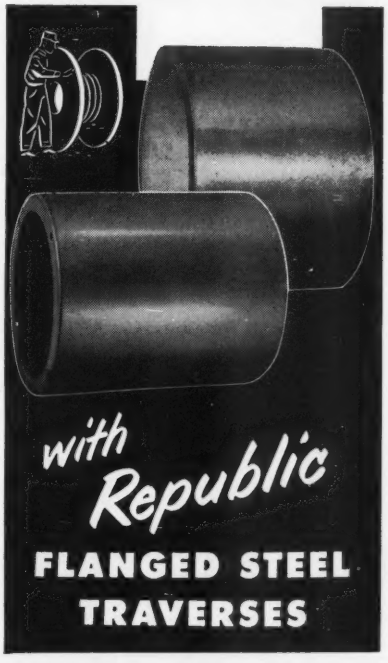
SIMPLE
4 STEP
ASSEMBLY
For Wire and Cable Reels



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FLANGED STEEL
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It's as easy as this:

1. Insert bolts through wooden head
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• No special tools—no experience necessary. Your reels will last for years—and save money.

Made in sizes up to 56-inch diameter and 48-inch traverse—in plain, painted or hot dip galvanized finish—as light as 18-gage steel. Width of flange and number of bolt and drain holes furnished to your specifications. Available for prompt delivery. Write for prices.

* * *

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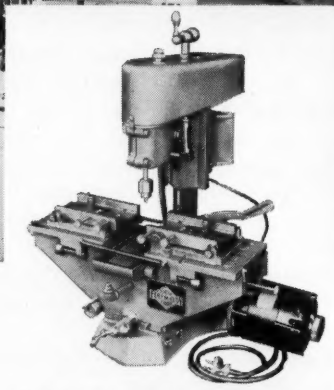


Firth Sterling Nail Die Barbing Machine

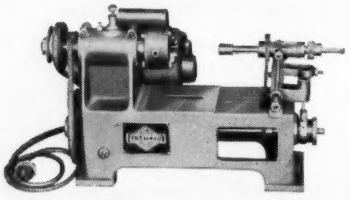
Firth Sterling can plan and equip one for you, too . . .

A well designed, well equipped and well organized die room soon pays for itself in savings resulting from longer die life, reduced downtime, smaller investment in die inventory and greater uniformity and quality of product resulting from precision tooling.

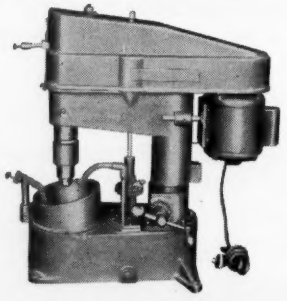
Firth Sterling, long a leader in the field with Firthaloy Dies, knows best die room practices as no other . . . and offers to the wire industry a complete die room planning and engineering service *right down to the machines to equip it.*

Firth Sterling tungsten carbide die finishing equipment is available from stock for complete tool room set-ups or as individual machines, according to your need.

Don't let an inadequate die room cost you money. Start the installation of a *modern* one by calling a Firth Sterling planning engineer. Do it now!



Firth Sterling Automatic Polisher



Firth Sterling Heavy Duty Ripper

R-315

Firth Sterling

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MODEL G II/TF II D

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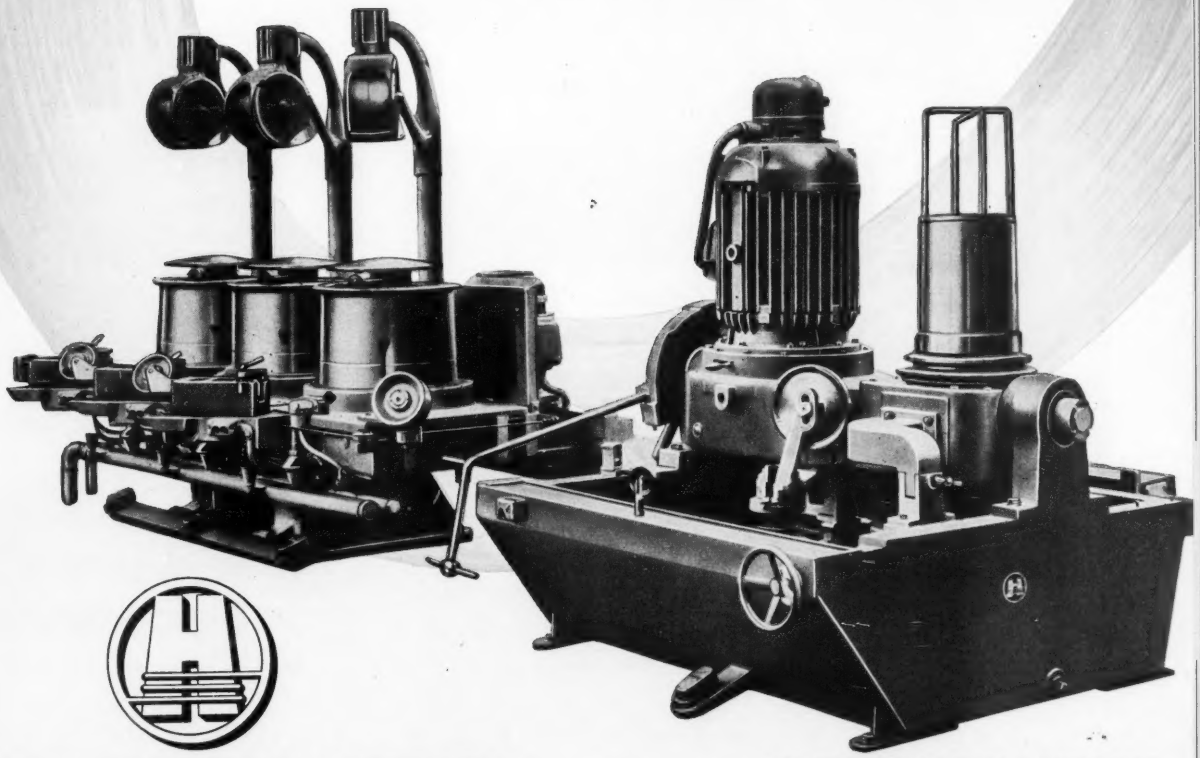
1) Drawing proceeds without interruption in one operation
2) Lower costs through combination of two operations
3) Finished wire with bright, flawless surface

Please submit your inquiries, we shall be glad to quote on your particular wire drawing problems.



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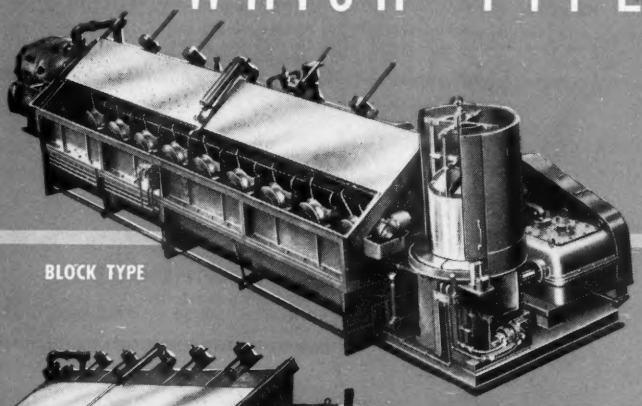
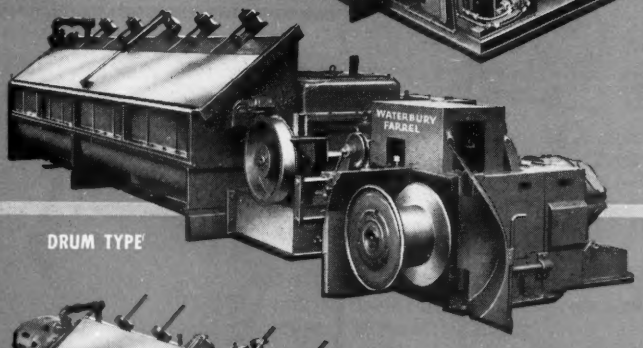
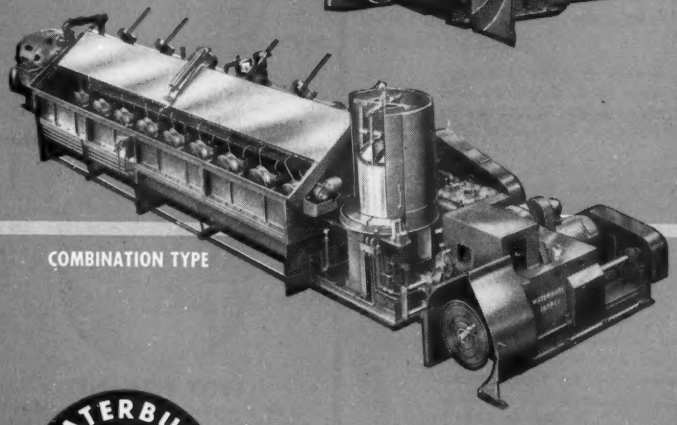


BLOCK TYPE



DRUM TYPE



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★ In all three types, Waterbury Farrel *custom-engineers* individual machines to specific requirements for high speed continuous drawing.

★ Each WF machine is backed by over 60 years of experience in designing and building tandem machines.

★ Rugged, precision construction throughout, assures smooth, efficient operation.

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Waterbury, Conn. U. S. A.

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Covers frames, dies and drawing rolls, driving mechanism, lubrication, packaging and accessory equipment. Gives table of specifications for two sizes. Use coupon or write on letterhead today.

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Please send me my free copy of your circular No. 786-W-3 on Tandem Wire Drawing Machines.

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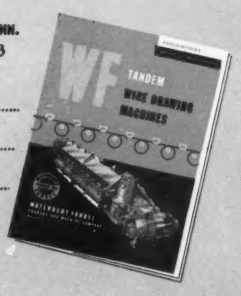
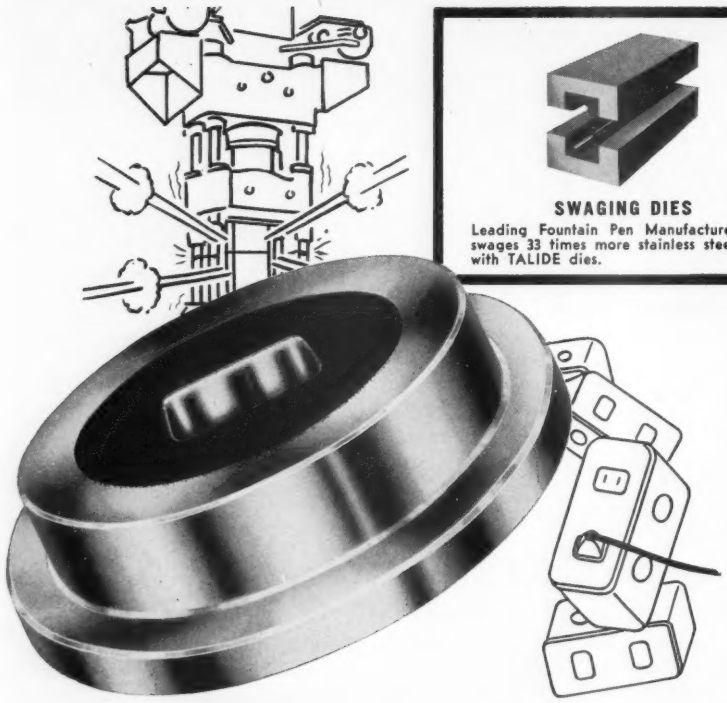
Company.....Title.....

Address.....

City.....Zone.....State.....

☐ Please have representative call.





SWAGING DIES

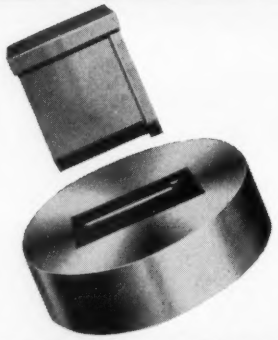
Leading Fountain Pen Manufacturer cold swages 33 times more stainless steel parts with TALIDE dies.

HEADING AND EXTRUSION DIES

Cold-heading 1/4". C-1008 steel rivets, TALIDE dies produced 11,200,000 pieces, other carbide dies only 3,500,000.

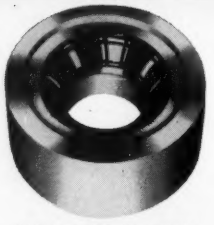
CURLING ROLLERS

TALIDE Curling Rolls last 65 times longer than steel rolls on beverage can forming operation.



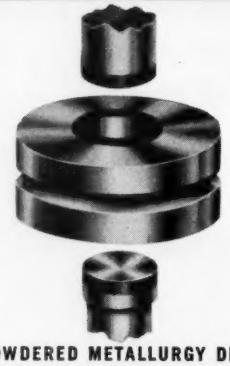
BLANKING AND FORMING DIES

70 times more paper discs blanked out with TALIDE — over hard alloy die.



SHEET METAL DIES

137,000 hi-alloy steel Pressure Vessels drawn with TALIDE, against only 7,900 with steel dies previously used.



POWDERED METALLURGY DIES

Compacting highly abrasive chemical powders, TALIDE Pill dies last 4 months, steel dies wore out in 6 hours.

25,680,000 PARTS PRODUCED with ONE TALIDE DIE

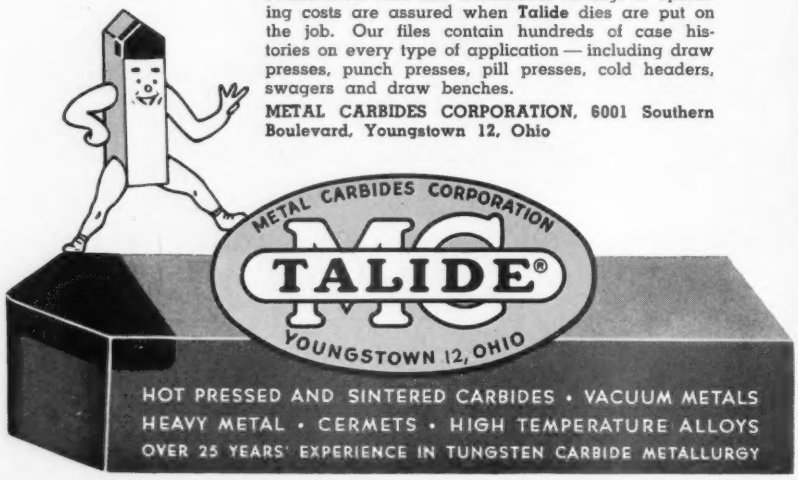
A large electrical equipment manufacturer was having difficulty maintaining production of electrical outlet boxes. Die costs were high, downtime and scrap excessive. It was necessary to remove and repolish the hi-carbon, hi-chrome die every 60,000 pieces. Total production secured from each steel die averaged 700,000 pieces.

After an initial survey, our die engineers designed and installed a **Talide** die using **Grade C-88.** Operation is performed on a 75-ton double action Bliss press. Original die was put in operation 3 years ago and is still going strong, having been removed only once for repolishing — after drawing 15,000,000 pieces!

Total production obtained to date has reached the astounding figure of 25,680,000 outlet boxes — 36 times more production than when using a steel die. The Talide die costs $1,125.00 compared to $500.00 for each steel die. Savings in die cost alone has amounted to over $18,000.00 over the past 3 years, with substantial additional savings realized in increased production. Downtime, repolishing cost and scrap expense were completely eliminated.

Call in a **Talide** sales engineer for recommendations on how to solve your particular die problem. Phenomenal runs and tremendous savings in operating costs are assured when **Talide** dies are put on the job. Our files contain hundreds of case histories on every type of application — including draw presses, punch presses, pill presses, cold headers, swagers and draw benches.

METAL CARBIDES CORPORATION, 6001 Southern Boulevard, Youngstown 12, Ohio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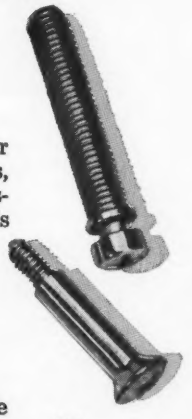
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY

CHECK THE ADVANTAGES OF STAINLESS STEEL FASTENERS

✓ for boosting product quality!

Where appearance and performance call for quality parts, don't overlook the advantages of stainless steel fasteners. Take the illustrated E. W. Ferry fasteners, for example. They're priced right in line with quality fasteners of other materials. Yet they offer all the extra qualities stainless steel brings to any part — high tensile strength . . . attractive, rust-resisting finish . . . and remarkable resistance to heat and corrosion. In almost any application they outlast, many times over, fasteners of nonresistant or plated metal. They cut maintenance costs, too. For even after years of service, disassembling rust-free stainless fasteners is always a fast, easy operation.



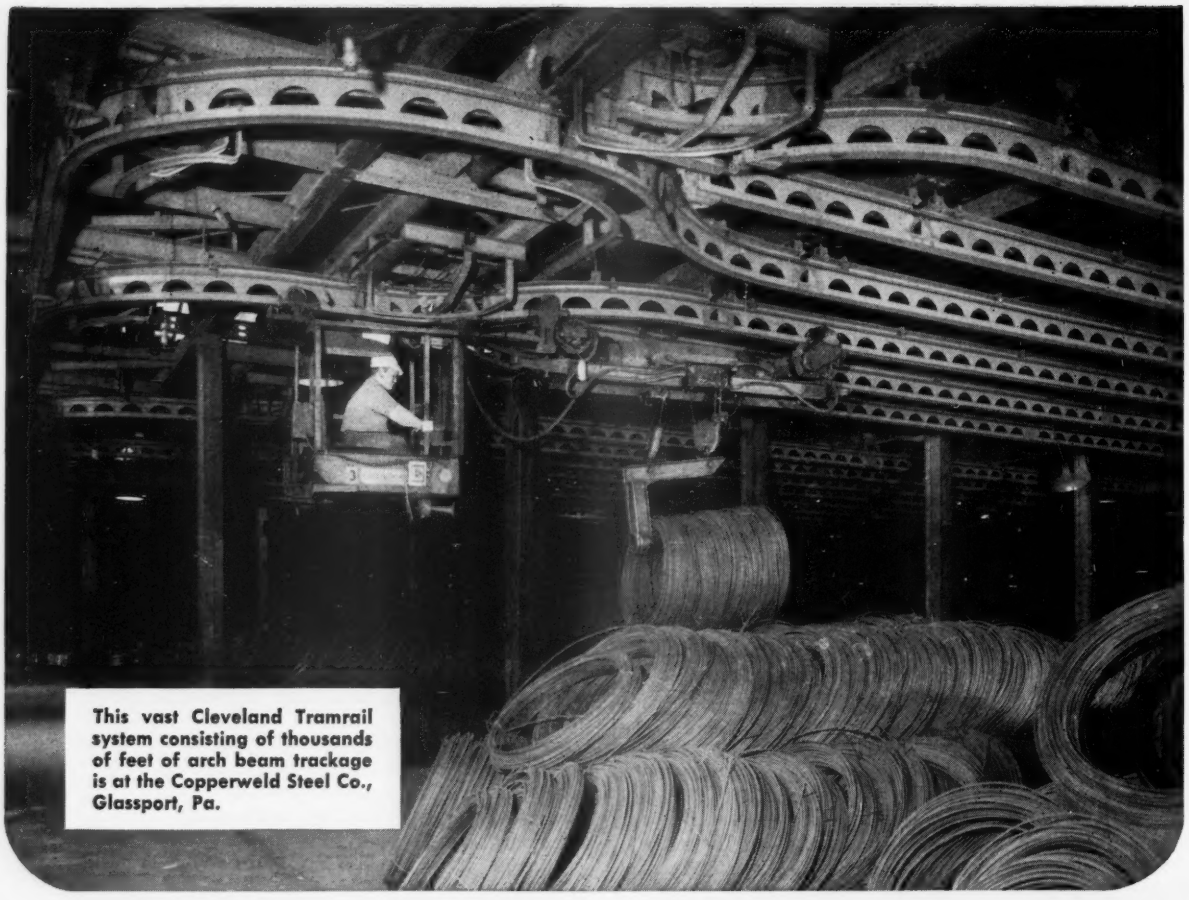
✓ for reducing production costs!

The hardness of stainless steel fasteners results in substantial savings on the assembly line. Work is faster, results are better — simply because stainless screw-heads are less apt to burr and nick. This means major savings, for even a slipping screwdriver can seriously damage both the screw and the parts being assembled. Stainless steel fasteners cut tooling costs, too. For they are now available in practically every size and description.

Crucible now offers stainless fastener wire in all diameters . . . in suitable tempers . . . in a variety of finishes, including bright and several metallic and nonmetallic coatings . . . in all standard grades. For prompt delivery of the stainless steel wire you need — or for your free copy of Crucible's new, 32-page catalog "Rezistal Stainless Steel Wire" — call or write to *Crucible Steel Company of America, Henry W. Oliver Building, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America



This vast Cleveland Tramrail system consisting of thousands of feet of arch beam trackage is at the Copperweld Steel Co., Glassport, Pa.

The *Most Practical* and *Lowest Cost* Method of Handling Wire and Rod

The headline words refer to overhead materials handling equipment and are powerfully strong, we admit. Yet we do not know of one engineer who is closely connected with the industry and experienced with all methods of handling, who will disagree.

Mills, large and small, from coast to coast, in the United States and Canada, have invested many millions of dollars in Cleveland Tramrail equipment to speed their wire and rod handling. The dividends that this huge investment has made possible, because of low-cost handling, have returned the original capital many times over.

If your company does not now enjoy the many benefits of Cleveland Tramrail, we urge you to get the "low-down" on what this equipment can do for you. A nearby sales engineer will be glad to give you the details without obligation.

GET THIS BOOK!
BOOKLET No. 2008. Packed with valuable information. Profusely illustrated. Write for free copy

CLEVELAND TRAMRAIL DIVISION
THE CLEVELAND CRANE & ENGINEERING CO.
9218 EAST 288 STREET, WICKLIFFE, OHIO

CLEVELAND TRAMRAIL
OVERHEAD MATERIALS HANDLING EQUIPMENT

flawless faster die finishing with scientific compounds

Modern die manufacturers such as New Jersey Carbide Die Co. demand Hyprez, the original Diamond Compound

HYPREZ

For economy of production and for finish to exact specification, New Jersey Carbide Die Co. uses Hyprez exclusively

High Precision DIAMOND COMPOUNDS

Serving many of the foremost plants in the wire industry, New Jersey Carbide Die Co., of Jersey City, uses Hyprez exclusively for rough finishing, lapping and polishing tungsten-carbide dies.

The continuing preference for Hyprez is built upon Hyprez superiority—maintained by research and control; by fast free-cutting action of pure diamonds precisely graded and uniformly dispersed in scientifically formulated vehicles. Hyprez provides the exact grade and concentration for every job.

Ask for a free demonstration

or technical bulletin No. W-256

HYPREZ DIVISION

ENGIS EQUIPMENT COMPANY, CHICAGO 5, ILL.

431 SOUTH DEARBORN ST.

HIGH QUALITY

fiber glass yarns for wire and cable insulation

Pittsburgh Fiber Glass yarns are made of exceptionally uniform continuous filaments, twisted and plied for any desired buildup. They are packaged for use with all standard types of serving and braiding machinery.

Pittsburgh yarns have proved their high quality with numerous manufacturers. If you have not yet put them to your tests, you are invited to make arrangements through our executive or district sales offices. Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.

FIBER PG GLASS

PAINTS • GLASS • CHEMICALS • BRUSHES • PLASTICS

PITTSBURGH PLATE GLASS COMPANY

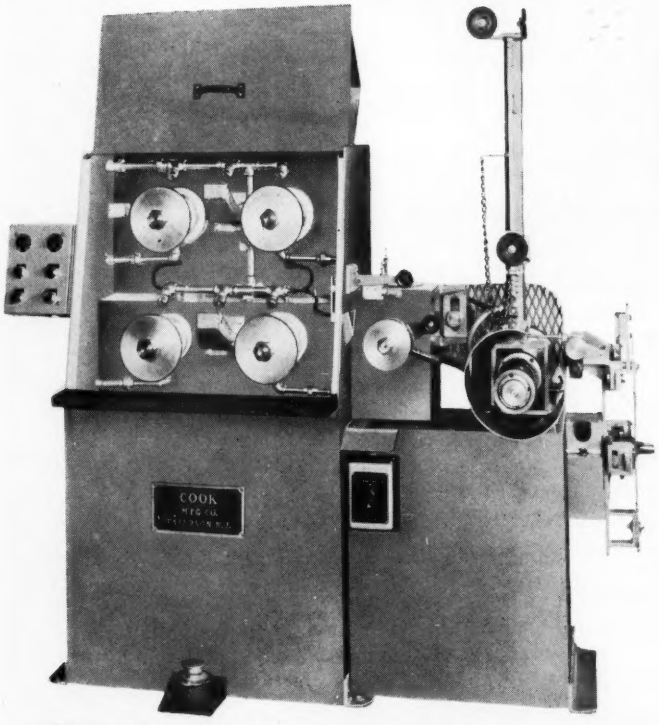
if you're a "doubting Thomas"-

(and what good engineer isn't!)

we proudly suggest that you ask those who have profited with Cook!

(names of users supplied upon request)

we're talking about low cost, long life



MODEL F-31

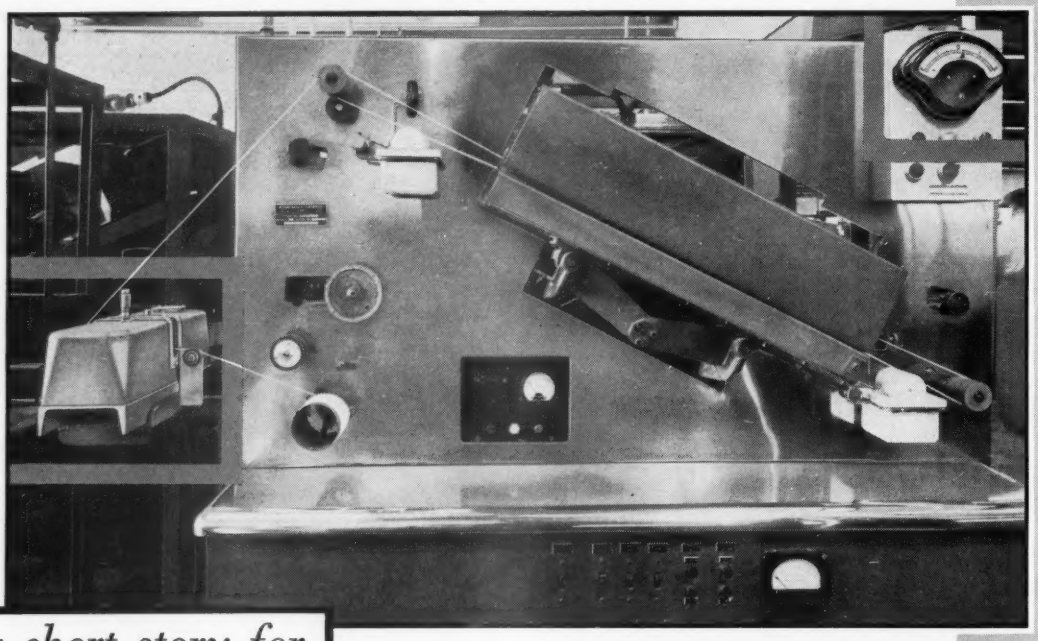
WIRE DRAWING EQUIPMENT

THE MODEL A-9 FOR EXTRA FINE WIRE, MODEL F-31 (ILLUSTRATED) FINE WIRE AND MODEL I-13 INTERMEDIATE WIRE DRAWING—PROVIDE A COMPLETE RANGE OF EQUIPMENT FOR DRAWING ALL NON-FERROUS WIRE AT HIGH SPEED AND LOW COST.

SPECIFICATIONS SENT UPON REQUEST

"draws out the best in wire"

COOK MANUFACTURING CO., 50 EAST 25TH ST., PATERSON, N. J.



a short story for insulated wire manufacturers

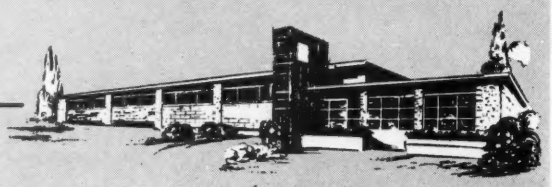
CBS HYTRON had a problem — coating small diameter wire (.005"-.015")* to meet new industry-wide specifications for the heaters of the electron tubes used in modern television sets. Specifically, the heating time characteristics of all tubes must be identical. This requires that the diameter of the coated filament wire be held to within ±½ mil — *one-half* the old tolerance.

They solved the problem with Industrial Gauges' MICROLIMIT CONTROL. With this automatic control of their coating machines they have been able to reduce tolerances to better than *one-third* the old standard. They also cut wire shrinkage and compound consumption *50%* and increased production yield by *10%*. (Eight out of the ten American producers of receiving tubes now use the MICROLIMIT CONTROL.)

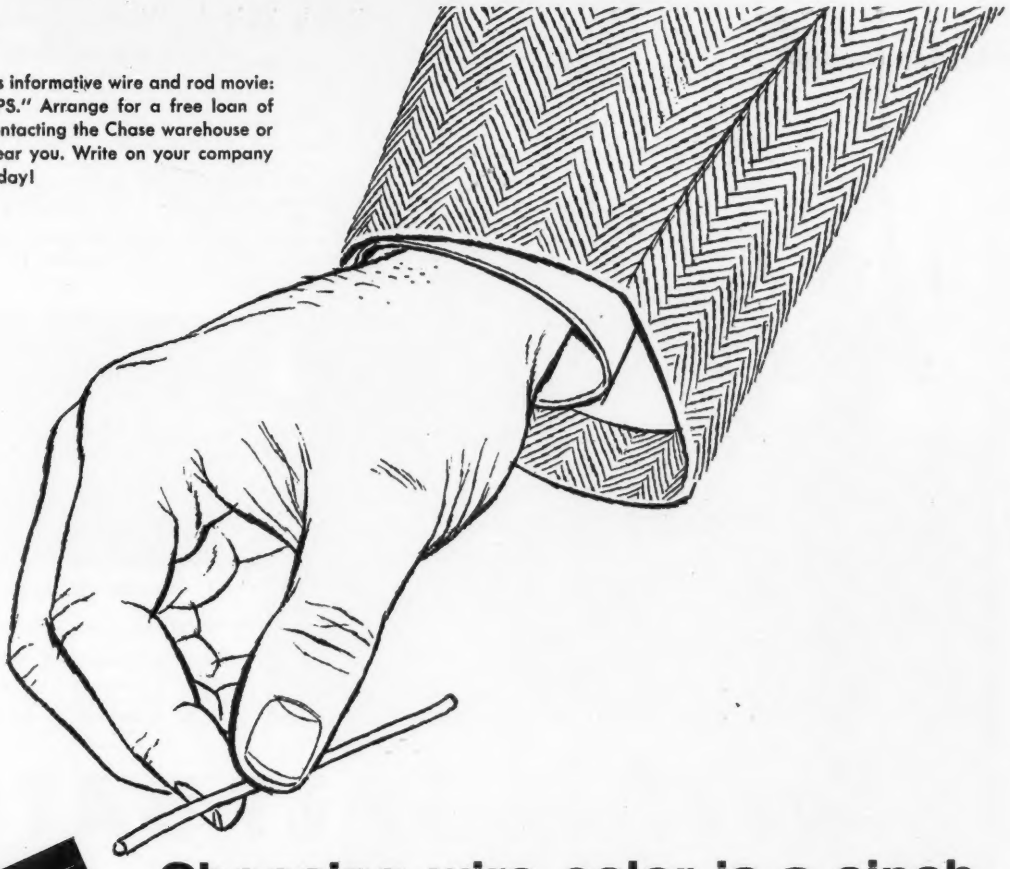
You may not be making filament wire but the MICROLIMIT CONTROL can help improve the quality of your product and reduce your costs, just as it helps CBS-Hytron.

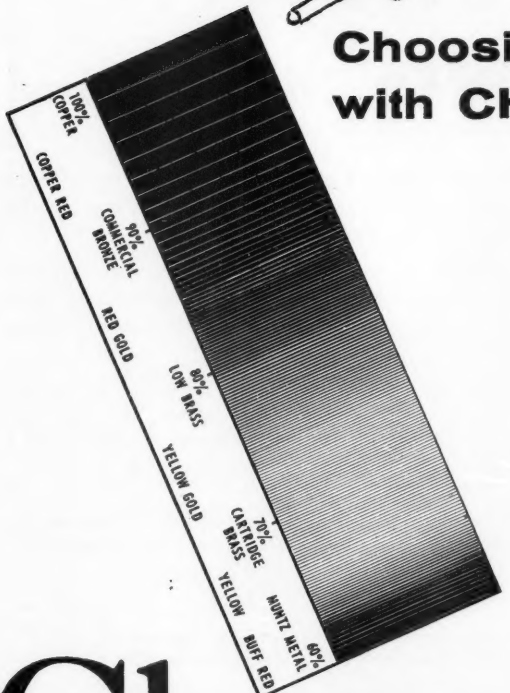
*We can supply continuous, non-contact gauges for automatic control of diameter of wires up to 3 inches in diameter.

INDUSTRIAL GAUGES CORPORATION
WEST ENGLEWOOD, NEW JERSEY



NEW! Chase's informative wire and rod movie: "IN THE CHIPS." Arrange for a free loan of this film by contacting the Chase warehouse or sales office near you. Write on your company letterhead, today!





Choosing wire color is a cinch with CHASE® on the job for you!

Dramatic changes take place in the color of brass wire, with as little as a 5% increase in zinc content. Most striking are the color shifts that occur as the zinc is increased from 15% to 35%.

That's where a Chase expert can come in mighty handy. He can tell you exactly which copper alloy wire suits your color requirements.

And you can count on every inch of Chase wire he recommends to be uniform in color. Chase's up-to-date annealing equipment makes it possible to consistently produce alloy wire with a high lustre and uniformity of color—plus a surface texture excellent for forming or heading operations.

The Chase warehouse near you can supply this superior wire from warehouse stock or enter your order for direct shipment from Chase mills. Give a call today!

CALL CHASE FOR STAINLESS STEEL TOO!

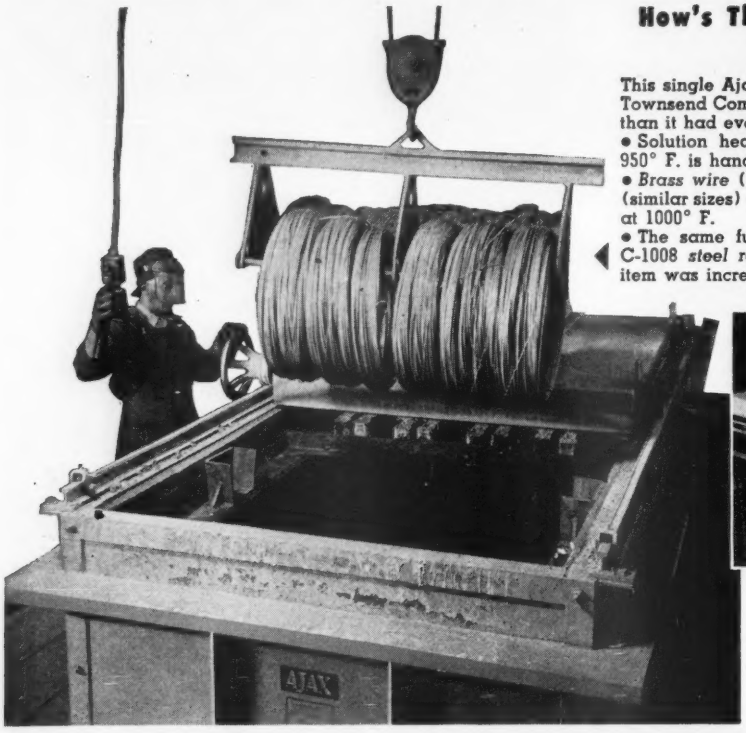
Chase®

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper (†sales office only)

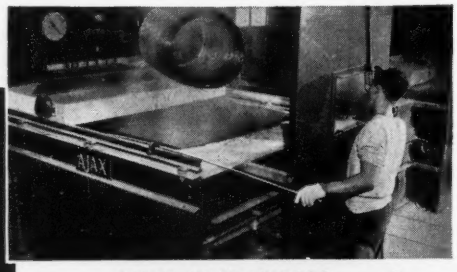
Atlanta	Chicago	Denver	Indianapolis	Minneapolis	Philadelphia
Baltimore	Cincinnati	Detroit	Kansas City, Mo.	Newark	Pittsburgh
Boston	Cleveland	Grand Rapids†	Los Angeles	New Orleans	Providence
Charlotte†	Dallas	Houston	Milwaukee	New York	Rochester†
	St. Louis	San Francisco	Seattle	Waterbury	



How's This for Heat Treating Economy PLUS Versatility?

This single Ajax Salt Bath Furnace does 3 different jobs for the Townsend Company, New Brighton, Pa. . . . and does each better than it had ever been done before.

- Solution heat treating of four different *aluminum alloys* at 950° F. is handled at 1,000 pounds per hour.
- *Brass wire* (65-35 from 1/16" to 3/8" diameter) and *copper wire* (similar sizes) annealed in batches of 1,000 pounds in 30 minutes at 1000° F.
- The same furnace is used for stress relieving cold headed C-1008 *steel rods* ½-inch in diameter. Production of this one item was increased 400%!



DONE IN MINUTES! ▲

A 250-pound charge of stainless steel wire is quickly brought to annealing temperature of 1850° F. in this Ajax electric salt bath furnace. Wire is essentially used for welding rods.

Save! with SALT BATH HEAT TREATING...the AJAX way!

No other process can match the Ajax Electric Salt Bath Furnace, for speed or low cost of equipment in the heat treating of steel, and non-ferrous wire.

You get greater and faster production in less floor space. Quality is improved—wire is heated more uniformly. Atmospheric effects (scaling and decarburization) are eliminated.

Summing up—the advantages of the Ajax Electric Salt Bath Furnace in specific applications are:

PROCESS ANNEALING . . . Bigger furnace charges heat treated in minutes instead of hours . . . scale eliminated . . . lowest over-all equipment investment . . . smallest floor-space requirement.

DESCALING . . . More work handled in less time . . . greatly reduced metal loss . . . minimized acid consumption by the Du Pont, the Virgo or the "Kolene" process.

PATENTING . . . Faster production with greater product uniformity . . . lower operating costs and, in many cases, the elimination of a separate cleaning operation.

CLEANING, PREHEATING and FLUXING (preparatory to aluminizing or other special processing) . . . Clean, scale-free surfaces obtained more quickly and at appreciably less cost.

Write for case histories—or, better yet, send a representative batch of work to our laboratory for treatment to prove our claims—no obligation.

AJAX®
HULTGREN

Associate Companies: Ajax Electric Furnace Corporation, Ajax Engineering Corporation, Ajax Electrothermic Corporation

electric SALT BATH furnaces

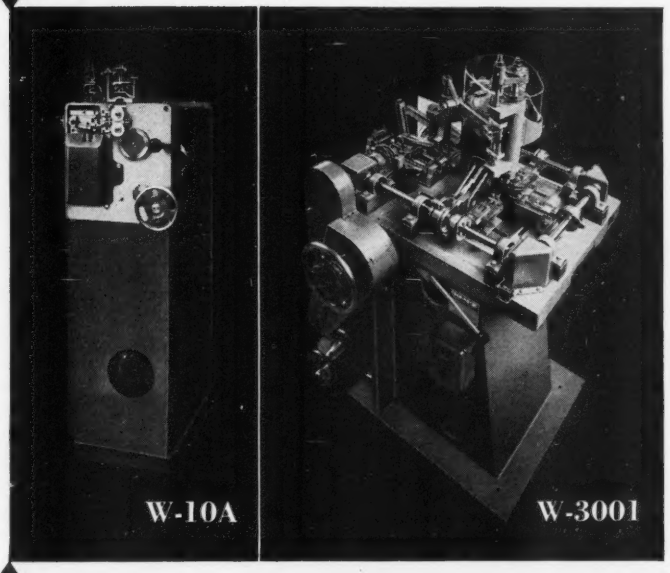
AJAX ELECTRIC COMPANY • 928 Frankford Avenue, Philadelphia 23, Pa.

The W-10A Springmaker
A completely modernized version of Torrington's famous W-10 coiler — long accepted as one of the standard machines of the Spring Making Industry.

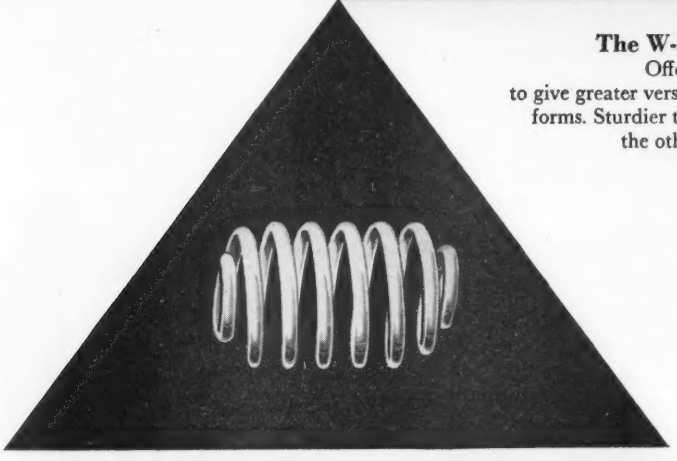
Springmakers take note!

These two new Torrington machines illustrate the breadth of Torrington's growing line of wire-forming equipment.

Torrington produces and *services* more wire-forming machinery than all other manufacturers combined! Write for detailed information on these two new machines — and on other Torrington equipment fitted to your needs.



The W-3001 Torsion Spring Winder
Offers extra large tooling area designed to give greater versatility in the production of complex forms. Sturdier tooling and faster set up are some of the other advantages of this new machine.



THE
TORRINGTON
MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT
WIRE FORMING MACHINERY DIVISION

Improved

SHAFTLESS TAKE-UP

General Specifications

Both side frames move in or out simultaneously, keeping center of reel traverse always in line with delivery point of cable, thus equalizing and minimizing cable deflection.

Reel gear and drive pinion remain in engagement at all times.

Quick traverse reversing by air valve.

Motor driven screw width adjustment.

Motor driven screw reel lift.

Traverse adjustable for reel width and cable diameter, while machine is running.

Traverse speed adjustable over range of cable diameters in increments of 1/20.

Drive can be supplied to suit customer's requirements.

Mechanical slip clutch friction drive for the capstan.

Variable speed motor drive with manual control.

Variable speed motor drive with automatic electrical control.

Available in the following sizes:

36" dia. reel to 52" dia. max.
36" dia. reel to 72" dia. max.
36" dia. reel to 84" dia. max.
42" dia. reel to 96" dia. max.

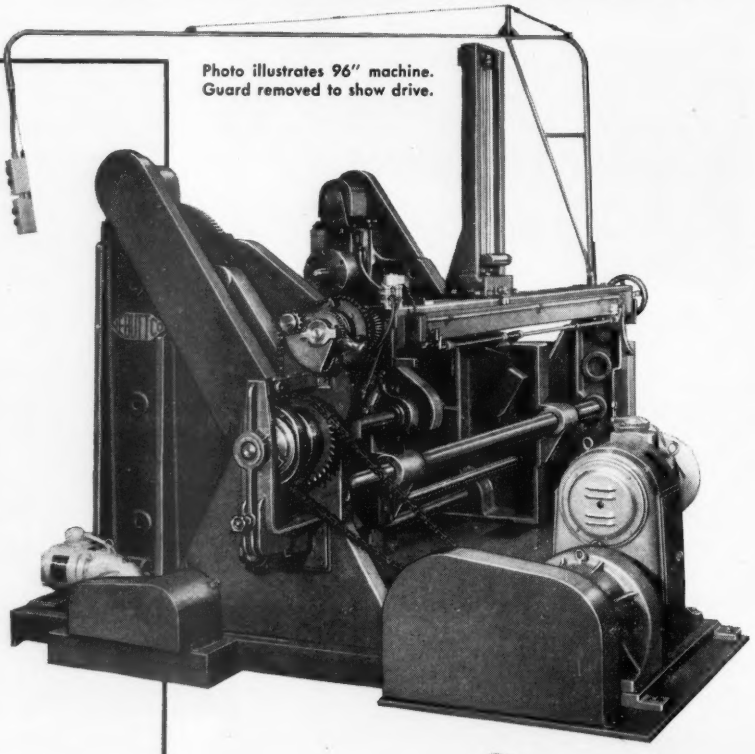
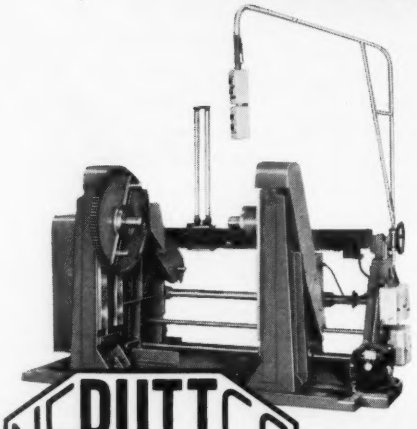


Photo illustrates 96" machine. Guard removed to show drive.

This heavy duty Take-Up includes latest developments which further increase ability to produce high quality cables. Many of these machines, in the previous model, are in continuous, trouble-free operation in plants throughout the country. It handles bare or insulated cables of all weights and sizes at a wide range of speeds . . . is readily controlled by the operator by means of the convenient swinging pendant push button station. Various drives can be provided and the machine readily adapted by our engineers to meet your special requirements. Write us for further information and details.



NEW ENGLAND BUTT CO.

DIVISION WANSKUCK COMPANY

304 Pearl Street · Providence 7, R. I.

In England — James Day (Machinery) Ltd., 28 Maddox Street, London, W-1.

NEBUTTCO

Braiders **Bunchers**
Cablers **Stranders**
Take-ups **Taping Machines**

A complete adjustable speed line

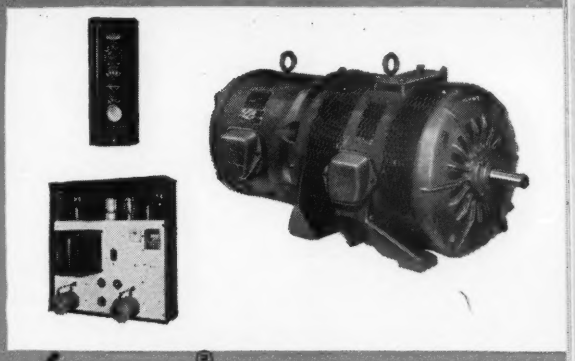
Get the right answer from Louis Allis

It pays to think first of the Louis Allis Co. whenever you're considering adjustable speed drives for your product or plant. Louis Allis builds all basic types. There's no compromising — from this complete line you can select the unit that's exactly suited to your job conditions and engineered for your application.

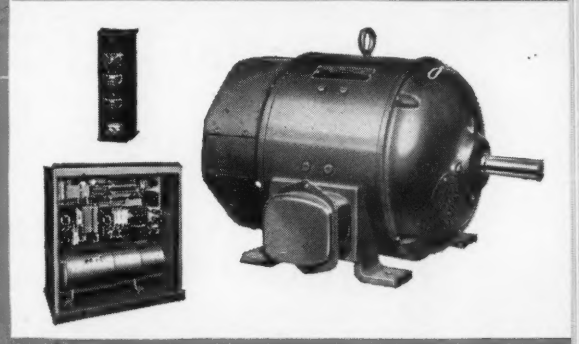
For the simplest — and best — solution to any adjustable speed drive problem, call your nearby Louis Allis Sales Engineer, or write to us.

THE LOUIS ALLIS CO.
MILWAUKEE 7, WISCONSIN

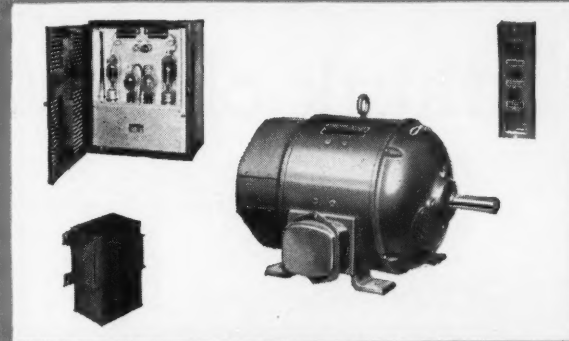
ASD-101



AJUSTO-SPEDE®. ¾ to 75 horsepower. A versatile eddy current clutch combined with a constant speed AC squirrel cage motor provides wide, continuous duty speed ranges. Tachometer feedback circuit offers precise speed regulation in an unusually compact drive. Many optional features available — dynamic braking, torque control, threading speeds, inching, jogging, multi-motor operation and range drives.



SELECT-A-SPEDE. 5 to 200 horsepower. New magnetic amplifier and adjustable voltage control provide superior speed regulation — better than required on most machines — from ⅛ base speed or less to full base speed. All-electric circuits — easily serviced. A.C. source, converted to D.C. by motor-generator set, drives adjustable speed D.C. motor. Many special control features available — reversing, dynamic braking, jogging, special programming or sequencing control, extra wide speed range. All drive motor enclosure available.



NEW! ELECTRONIC SELECT-A-SPEDE. ¾ to 15 horsepower. D.C. adjustable speed drive motor operates from A.C. electronic power unit. Infinitely adjustable speed ranges 5:1, 20:1, 50:1, 100:1 available. Unusually close speed regulation to ½% with optional tachometer feedback circuit. Included as standard are: dynamic braking, torque limit, line voltage compensation. A few available modifications include: reversing, jogging, threading, and quick slow-down. All motor enclosures and control stations — from open to explosion-proof.

think of... Kaiser Aluminum

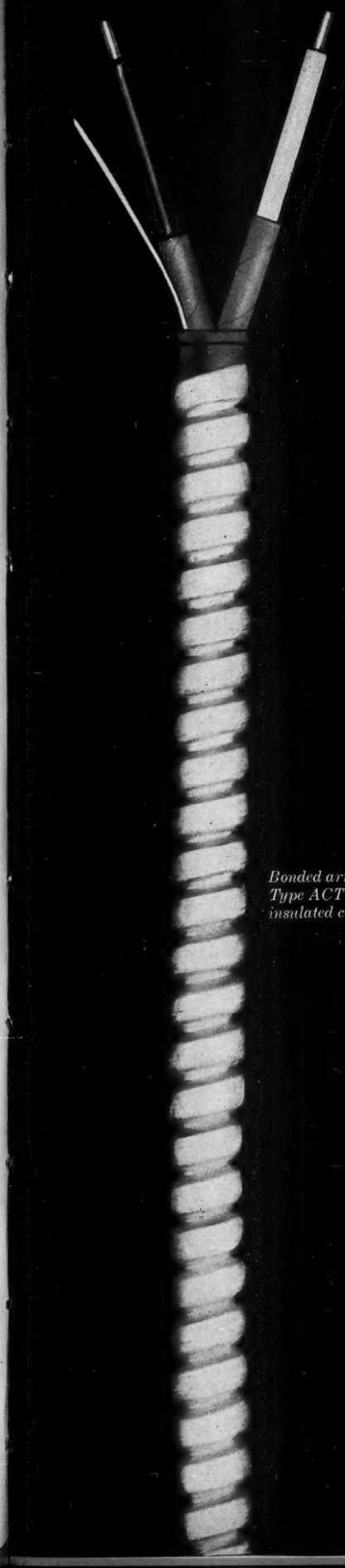
To MEET the growing demands for aluminum rivets and threaded fasteners, Kaiser Aluminum produces for manufacturers a broad line of high quality rod and rivet wire.

Kaiser Aluminum wire is produced in sizes from 0.061″ to 0.374″ in diameter. Rod is produced in sizes from 0.615″ to 0.375″. Both are regularly available in six alloys: 1100, 2017, 2117, 2024, 6053, 5056. Others can be produced on request.

The many quality controls on Kaiser Aluminum rod and rivet wire assure rivets and fasteners that are strong, free from flaws and attractive in appearance—*that will meet or exceed minimum strength requirements.*

In addition to rivet wire and rod, Kaiser Aluminum also makes available a complete line of round drawn wire and hexagonal wire in a wide range of diameters, alloys and tempers. Redraw rod and redraw wire are available for further drawing into finished products.

For immediate attention to your needs, contact the Kaiser Aluminum sales office listed in your telephone directory. Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office,* Palmolive Bldg., Chicago 11, Illinois; *Executive Office,* Kaiser Bldg., Oakland 12, Calif.



Bonded armored cable, Type ACT, with Opalon-insulated conductors.

Another Monsanto First!

Armored cable with Opalon* vinyl insulation gets U-L recognition!

Opalon improves wiring efficiency—and helps simplify installation!

A new and more efficient armored cable construction has just been perfected. And for the first time cable utilizing vinyl insulation has won recognition from Underwriters' Laboratories.

Builders and electrical contractors will be impressed with the outstanding physical and electrical properties of this cable's conductors which are insulated with Monsanto's Opalon compound.

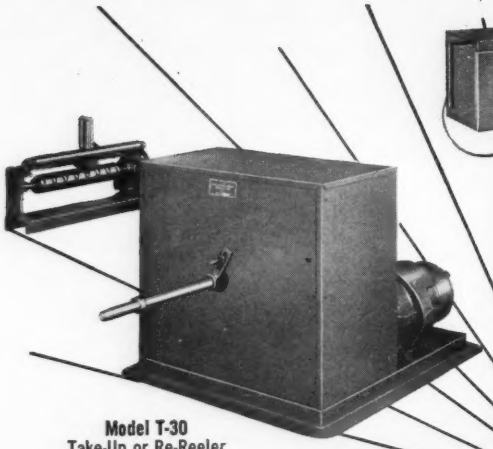
This thermoplastic coating is so tough it reduces the possibility of shorting when wires are pushed over sharp edges in the junction box. Stripping is neater and easier because there is no fraying of the insulation. Color identification is permanent.

This trail-blazing development in wiring was pioneered by three of America's most progressive manufacturers—Columbia Cable & Electric Corp.; Clifton Conduit, Inc.; and Ettco Wire & Cable Corp.—working closely with Monsanto.

For data sheets and complete information on Opalon electrical compounds, write Monsanto Chemical Company, Plastics Division, Room 1117, Springfield 2, Mass.

MONSANTO

*OPALON: REG. U. S. PAT. OFF.

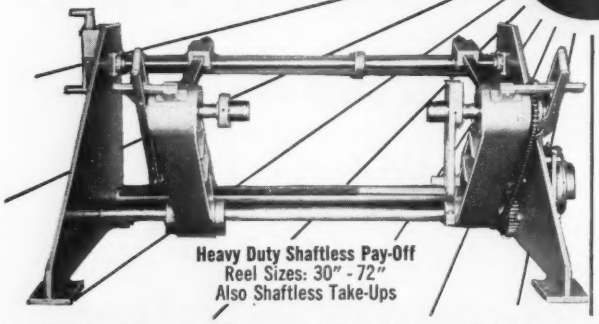


Model T-30
Take-Up or Re-Reeler

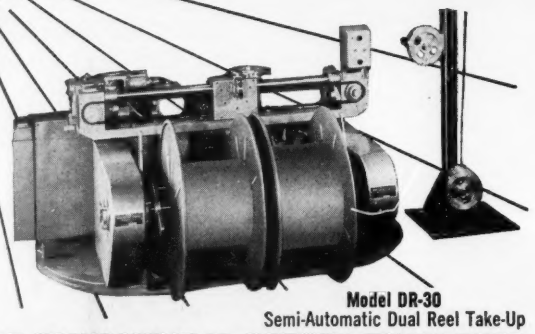
No. 4 Spark Tester
Automatic Resparking for Re-Reeling

CV Type Sparker
For Continuous Vulcanizing
or Plastic Extruding

FOR ACCURACY — DAVIS WIRE & CABLE EQUIPMENT — FOR DEPENDABILITY



Heavy Duty Shaftless Pay-Off
Reel Sizes: 30" - 72"
Also Shaftless Take-Ups



Model DR-30
Semi-Automatic Dual Reel Take-Up

THE NEWLY REDESIGNED *DAVIS WIRE & CABLE EQUIPMENT* IS BETTER THAN EVER

Modernized, streamlined and engineered for fast production of safely insulated wire and cable, the newly redesigned DAVIS ELECTRIC line of Spark Testers, Pay-Offs, Take-Ups, Counters, Spoolers, Traverses and Capstans is now offered as the finest ever conceived and produced by DAVIS ELECTRIC engineers. Before you buy, you owe it to your pocketbook as well as your business reputation to learn what this unexcelled machinery can do to better satisfy your customers (and your stockholders!). Refinements and advancement in designs qualify the 1955 DAVIS ELECTRIC line to surpass in performance previous DAVIS products in use in 80% of the industry's wire mills and some of which have been in operation for 15 years without maintenance problems!

What better tribute to quality can one ask?

Write for complete details and find out how DAVIS ELECTRIC can improve your wire and cable production and promote profit in your plant.

DAVIS
WIRE & CABLE
EQUIPMENT

Davis ELECTRIC CO.

WALLINGFORD, CONN., U.S.A.

HARNESS TESTERS ★ PAY-OFFS ★ TRAVERSES
SPARK TESTERS ★ SPOOLERS ★ TAKE-UPS ★ CAPSTANS

Correspondents throughout the world

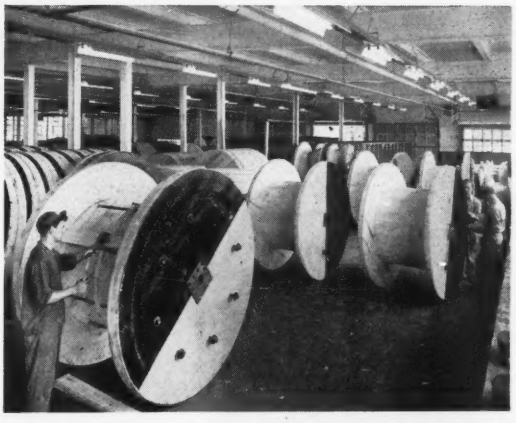
Foreign Sales Representatives: OMNI PRODUCTS CORP. 460—4th Avenue, New York 16, New York

ever

and think....

of what it costs $ annually to ship your Electrical Wire and Cable the old fashioned way?

NOW is the time to check and compare with the savings that can be realized by the use of NON-RETURNABLE wood shipping reels.



Look at these advantages:

- *Reduced Reel Investment*
- *Less Storage Space*
- *Lower Freight Costs*
- *No Repair Costs*
- *No Return Freight Costs*
- *No Bookkeeping*
- *No Cash Deposits Req'd.*
- *No More Headaches ! !*

MANY of your current problems can either be greatly reduced or completely eliminated through the use and advantages of **NON-RETURNABLES.**

NON-RETURNABLE REELS ALLOW DEFINITE PACKAGING COSTS.

HIGH SPEED

SHIPPING SERVICE in our... OWN TRUCKS

within a radius of 200 miles from the plant. Fast freight will bring you Bridge reels in 5 days or less east of the Mississippi.

BRIDGE
MANUFACTURING COMPANY
HAZARDVILLE, CONNECTICUT

Telephone . . .
Thompsonville, Connecticut
Riverview 9-8308

"REEL GOOD . . .

Let us quote on your reel needs. Send your specifications. Better yet, visit our plant and see how and why our reels are made so well at so low a cost.

WOOD REELS"

...SWIFT'S SOAPS are the efficient lubricant for wire drawing

IMMEDIATE DELIVERY ON THESE QUALITY SOAPS...

- Powdered White Ribbon
- Guaranteed Powder
- Snap Heavy Duty Wire (Drawing Powder No. 282)
- No. 559 Powdered Soap

Whether it's used for chicken wire or cable, all wire has this in common: speed is profit; and with speed comes heat.

With increased heat, more draws and *less* cooling time between draws, a compromise with the quality of your drawing lubricant is a compromise with the efficiency you purchased in high speed equipment.

Swift's wire drawing lubricants are stable, efficient and dependable *because* they are produced to uncompromising standards of quality... standards established through constant attention to the specific needs of our many and varied customers. Included are an ever increasing number of specific soaps for specialized protection... a continually expanding, versatile line of products designed to help you make the *most* of high speeds, the *least* of heat and stress.

That's why your Swift man is a *single source* for resourceful service. 375 distribution points throughout the U. S. and Canada can provide prompt delivery and courteous service. Write for details and remember...

ONE TRIAL IS BETTER THAN A THOUSAND CLAIMS

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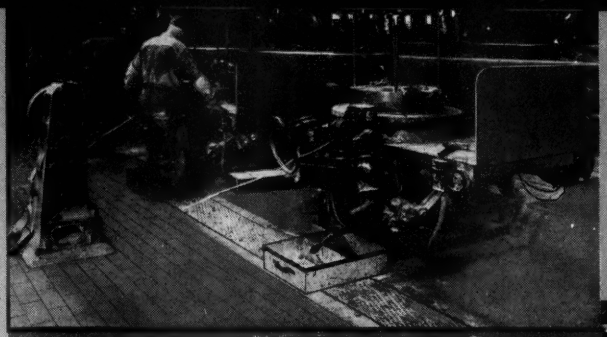

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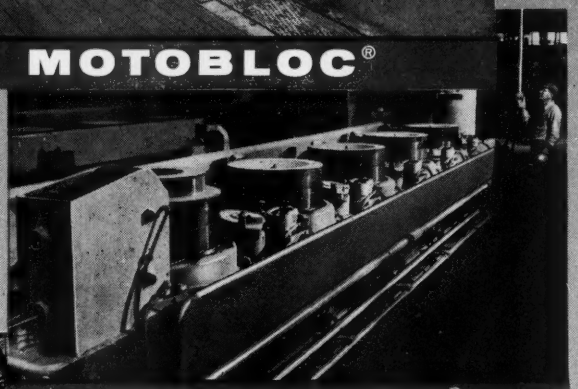

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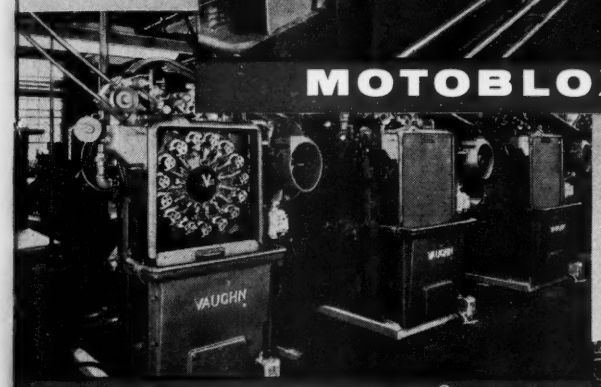
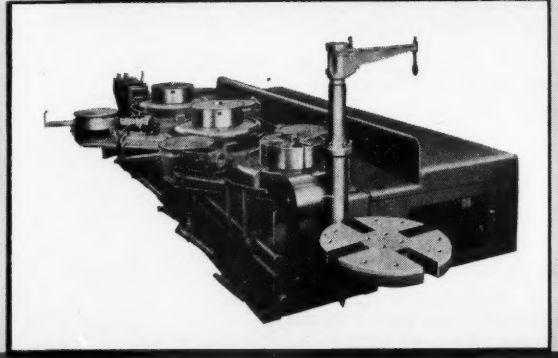


RINGBLOX®

TANDEM CONTINUOUS MACHINES



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From the largest tube or bar to the finest wire, ferrous or non-ferrous, it pays to specify **Vaughn**

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COMPLETE COLD DRAWING EQUIPMENT—Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys

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Nuts produced by Lamson & Sessions, Cleveland, Ohio.

Get more production with this

SCRAPLESS NUT QUALITY WIRE

Youngstown Scrapless Quality Nut Wire. The wire with the accurate sizing. The right composition. The wire that measures up to chemical and metallurgical checks for analysis. Micro-examinations, too.

Scrapless Quality Nut Wire with these qualities feeds smoothly through your machines. There is less downtime. Fewer rejects. And severe die wear is lessened.

Next time you order Scrapless Quality Nut Wire, be sure you get Youngstown. It's available in a good range of compositions, including AISI Standard as well as special re-sulphurized steels. For more information, call your nearest Youngstown District Sales Office.

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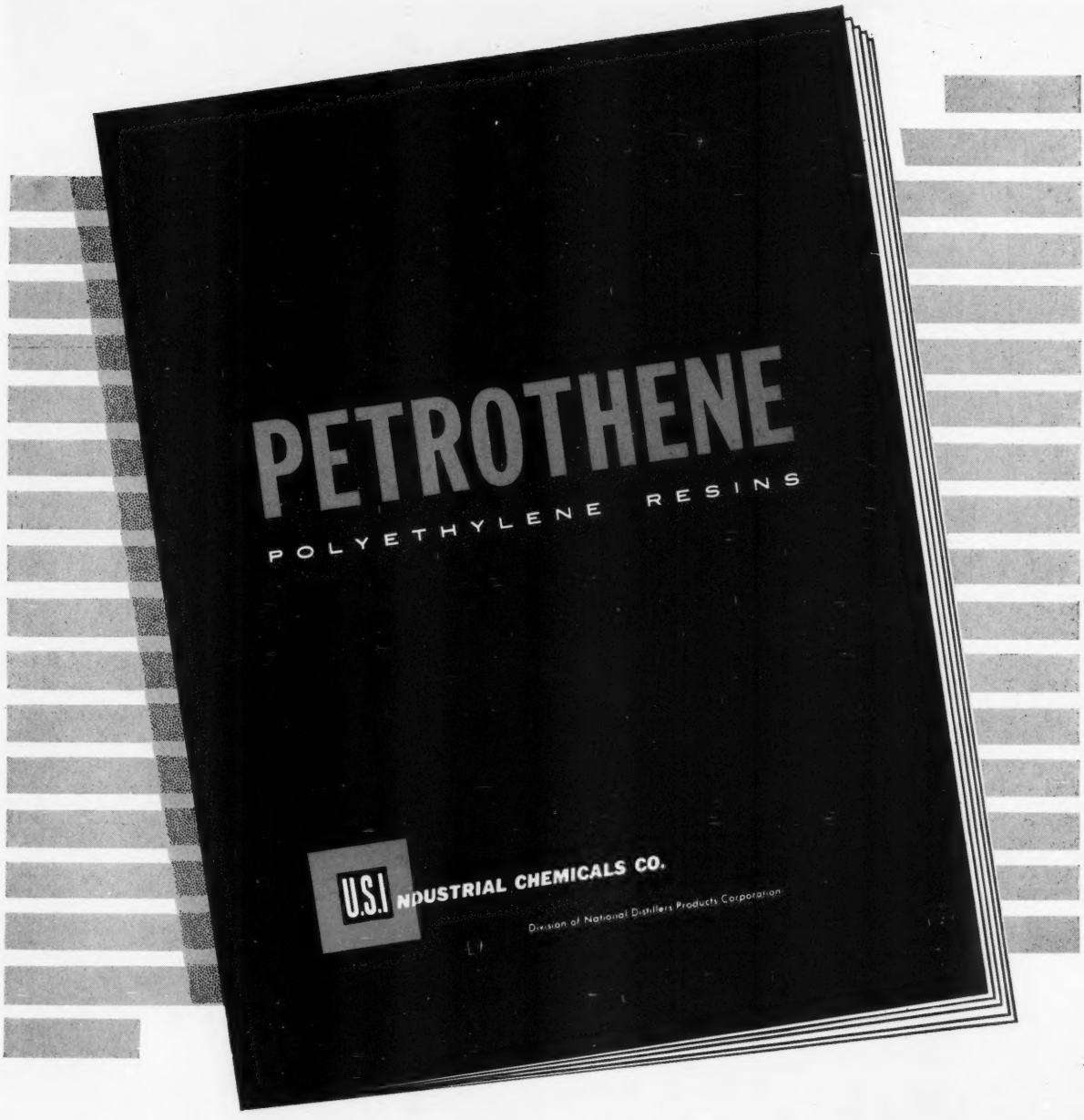

This new booklet is for the polyethylene processor interested in high-quality molding and extrusion resins.

It tells why the PETROTHENE* production facilities can give him a resin with melt index and other physical properties more consistent than that of any molding and extrusion resin available up to now. It also gives description, preparation, properties, uses, methods of processing and U.S.I. services.

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Division of National Distillers Products Corporation
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Please send me a copy of your new brochure "PETROTHENE Polyethylene Resins."

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THE FOUR-IN-ONE CONTINUOUS BAR and ROD MAKING MACHINES

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BARS or RODS
Round, Square, Hexagon, Rectangular, Special Shapes
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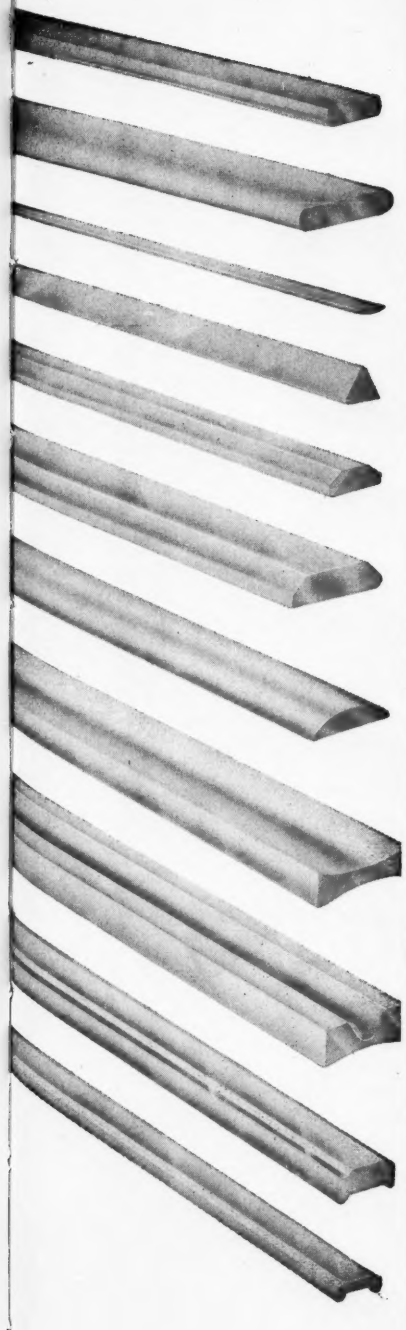

NATIONAL WIRE

(COLD ROLLED)

in Coils or Straight Lengths

COMPLETE METALLURGICAL SERVICE

Manufacturers of

SPRING WASHERS	RETAINING RINGS
ROUND EDGE FLAT WIRE	KEYSTONE SHAPED WIRE
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Shaped Wire in Coils or Straight Lengths, Ferrous or Non-Ferrous.

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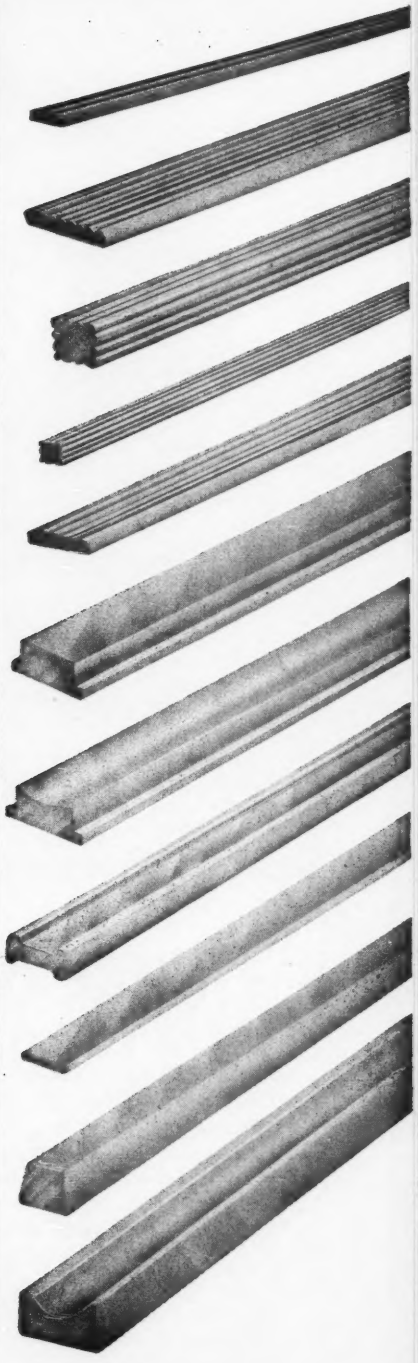

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PRECISION SHAPED WIRE DIVISION

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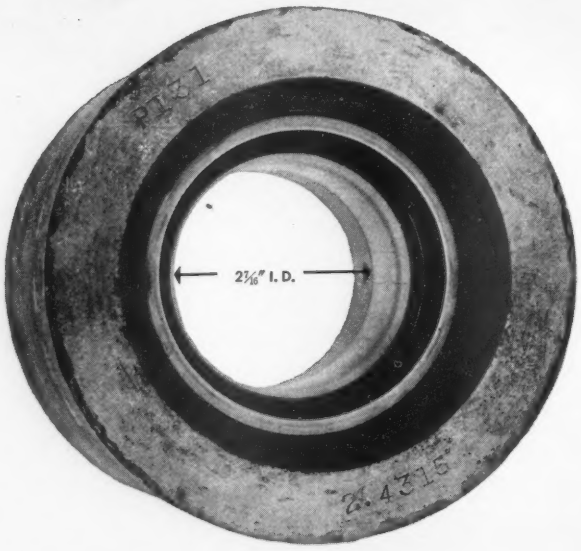


Carboloy R-16 Die operated 26 months without polishing

Over 5,000 tons of steel were drawn by this R-16 die in 26 months . . . without developing an approach wear ring. During that time, the 2.4315" hole increased only .0025"—about one-tenth of 1 percent. (R-16 die shown one-half size.)

Carboloy R-3 Die resized 20 times . . . to 30% over maximum

Before its first resize, this R-3 die had already drawn more wire than its user expected on the first size. After its 20th resize, the die was still producing high-quality wire—with a hole 30% larger than normally recommended maximum. (R-3 die shown full size.)

THERE IS NO "NORMAL" SERVICE LIFE FOR CARBOLOY WIRE DIES

There's no such limit as "normal" service life with Carboloy® Wire Dies. Time and again, mill records prove these dies deliver far more than is expected.

Outperform other carbide dies

The R-16 die, at left, drew more than 5,000 tons of solid bar stock before it required polishing . . . breaking all previous carbide drawing records at Wyckoff Steel Company.

The story of the R-3, at right, is equally impressive in terms of effective service life. When the die was finally retired, the original .025" hole had been resized 20 times. The final .236" hole was 30% larger than the maximum .182" normally recommended—yet wire quality was maintained.

Get these "bonus" services

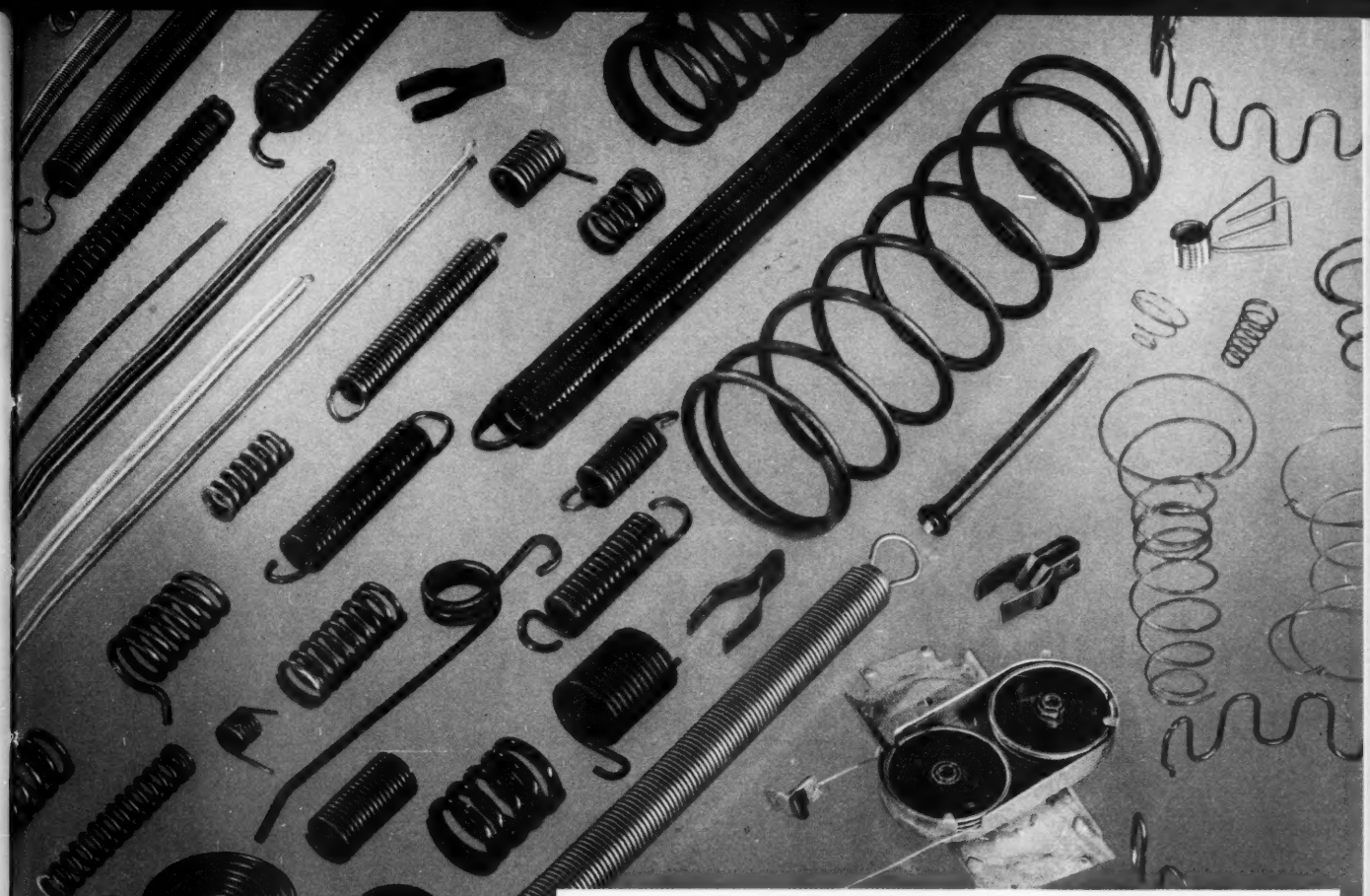
1. On-the-job engineering service
2. Immediate local delivery
3. Available die servicing facilities

Whether your business is drawing, flattening, extruding, or heading, there's a Carboloy product to fit your needs. For more information, or in-plant assistance, write today.

"Carboloy" is the trademark for products of the Carboloy Department of General Electric Company

CARBOLOY
DEPARTMENT OF GENERAL ELECTRIC COMPANY
11171 E. 8 Mile Ave., Detroit 32, Michigan

Carboloy Created-Metals for Industrial Progress



IF YOU MAKE *Springs*

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ROEBLING makes high carbon steel spring wire and flat spring steel... and makes it *better*... for every sort of spring and for every product that requires spring characteristics. Hard drawn, hard rolled, annealed or soft, tempered or untempered ... they're all available to meet your requirements exactly.

Among these Roebling materials are zig-zag and no-sag wires; mechanical and valve spring wires; music wire; clock and motor type spring wires; flat spring steel and upholstery spring wire of all types. The variety of parts into which these are formed is almost endless, but manufacturers all report that Roebling quality and uniformity reduce machine downtime.

Learn for yourself how Roebling can help your production and product. John A. Roebling's Sons Corp., Trenton 2, N. J.

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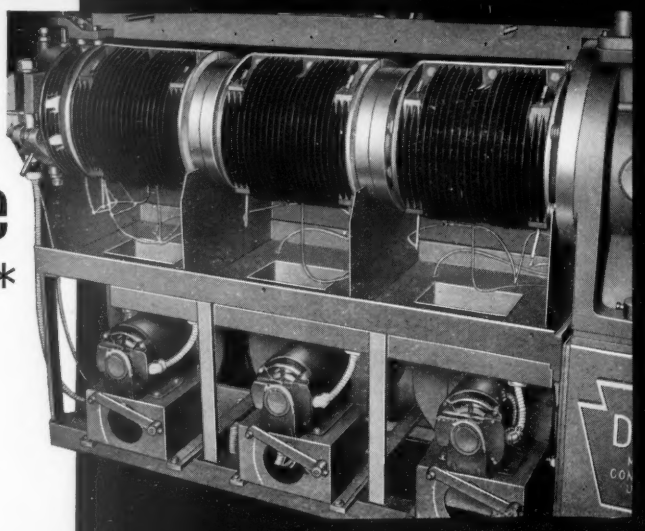
Q. What Makes The *THERMA-FIN* * Extruder Different?



A. EXCELLENT TEMPERATURE CONTROL

Those manufacturers who are familiar with the operation of extruding machines are well aware of the important part temperature control plays in determining the quality of extruded thermoplastic material. Prior to the development of the Davis-Standard *THERMA-FIN*° Extruder, users of thermoplastic extruders encountered many difficulties in trying to maintain close temperature control for various operating conditions. A common problem was that of removing excess heat from the extruder barrel, and this problem frequently placed objectionable limitations on the operating conditions.

In developing the *THERMA-FIN*° Extruder, emphasis was placed on the design of a cooling system that would provide excellent temperature control over a wide range of operating conditions. The effectiveness of this new technique developed by Davis-Standard has been proven repeatedly, and customer response to it has been most gratifying.

The "heart" of the *THERMA-FIN*° temperature control system is shown in the illustration above. Each cylinder section, or zone, is heated by means of heating elements cast in heavy-walled, aluminum half cylinders. Their external surfaces are finned to provide a large heat transfer area, and each section is individually cooled by a blower located below it. Baffles are located between sections so that the temperature of each section can be adjusted independently. The shape of the extruder cover is such that each cylinder section is cooled evenly.

*U. S. Patents Pending.

For additional information on THERMA-FIN° Extruders, write to:

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SOLE SELLING AGENTS FOR...**THE STANDARD MACHINERY COMPANY,** World's Largest Manufacturers of Custom-Built Extruding Machines

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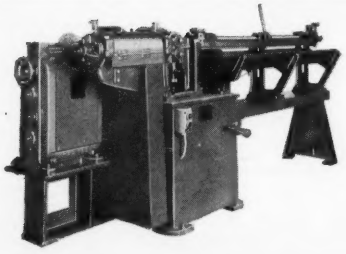
WIRE STRAIGHTENING SPECIALISTS FOR 90 YEARS!

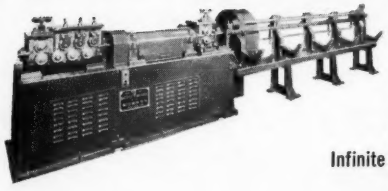
SHUSTER wire straightening and cutoff news!

SHUSTER — the first name in wire straightening and cutting, now presents a full range of *infinite variable speed* machines — first in the field again!



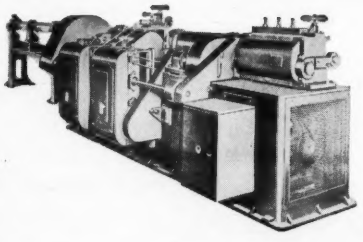
SHUSTER 1 AV

1/16″ to 3/16″ or 3/32″ to 1/4″ basic wire Geared to feed **any** speed from 50 to 200 feet per minute.



SHUSTER 3 AV

1/4″ to 1/2″ basic wire. Geared to feed **any** speed from 76 to 228 feet per minute. Infinite speed control of cuts per minute



SHUSTER 4 AV

3/8″ to 11/16″ basic wire. Geared to feed **any** speed from 90 to 180 feet per minute. Infinite speed control of cuts per minute.

INFINITE VARIABLE SPEED DRIVE!

Infinite feed changes and control.
The speed you want when you want it.
Constant speed maintained when set regardless of load variations.

ELECTRICALLY CONTROLLED CLUTCH AND TARGET!

Fewer wearable parts.
Roll type mechanism.
Solenoid actuated, feather touch control!

MINIMUM MAINTENANCE!

Frees operator from worry!
Speeds Production!

Send for FREE wall size split gauge wire chart from 41 gauge to 7/0

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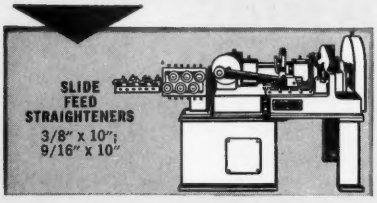
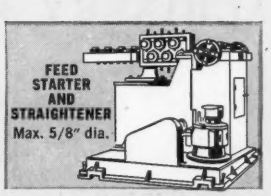
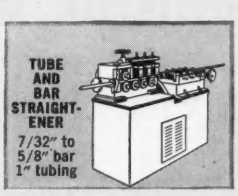
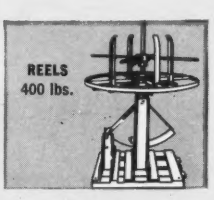
This too is SHUSTER.

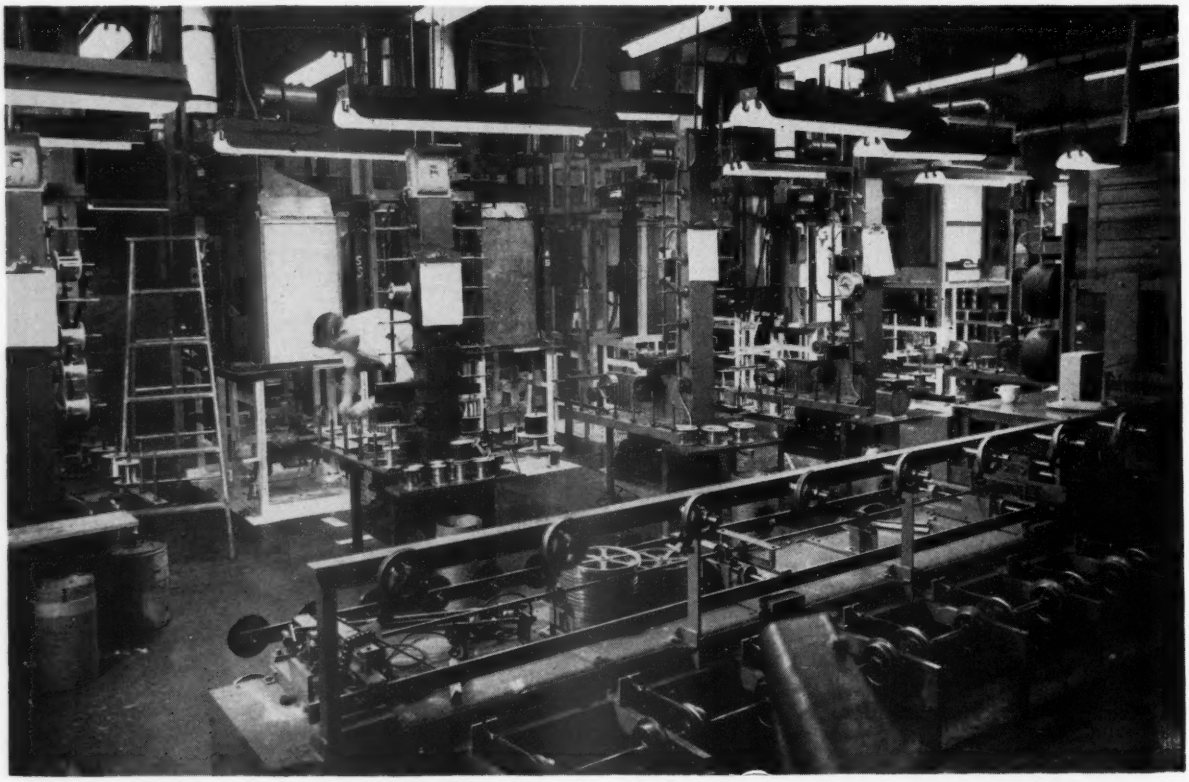








Woodside ENAMELING TAKE-UPS



Woodside Wire Enameling Take-Ups in operation in large electric wire plant. Photo shown through the courtesy of HITEMP WIRES, INC., Mineola, Long Island, New York.

WOODSIDE builds special machinery drawing fine lead, brass, bronze, copper stainless monel and precious metal wires.

OTHER MACHINES BUILT

TINNING
FINE WIRE RESPOOLING
STRAND ANNEALING FURNACES
COIL TAKE - UPS
STRIP ANNEALERS AND TAKE - UPS

These Take-Ups have 12 spindles and are driven by a U.S. vari-speed motor with speed ratio of from 5 to 50 ft. per min. This unit is being used exclusively by a well-known manufacturer of Teflon insulated magnet wire.

Handles a wire size range of 46 up to 26 gage. This machine can be easily converted for single or double enamel wire take-ups. It is versatile and also can be used as a small, compact respooling device.

Dimensions of the unit are: height 82″; width, 31″ and length, 24″. This saves much floor space.

The machine is adaptable to take 5, 10 and 25 lb. spools. Equipped with ball bearing pay-offs, mounted on the machine.

Your Inquiries Are Invited

WOODSIDE MACHINERY DIVISION
of
INTERNATIONAL WIRE PRODUCTS CORP.

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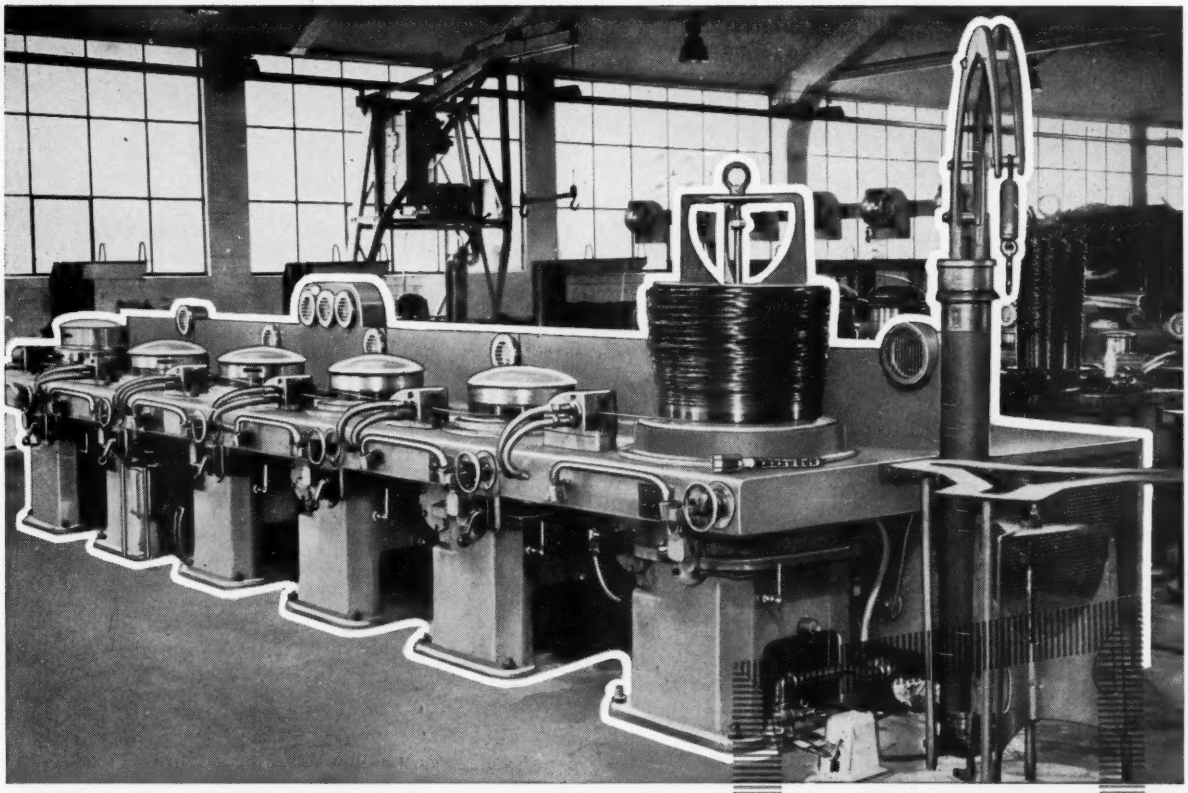

This picture shows a Beeline DG 4, built for an inlet wire diameter of about 7 mm (approx. 2 SWG). High carbon steel.

THE **BEELINE** WIRE DRAWING MACHINE

Straight-line type Wire Drawing Machine for high production of all wire grades

Prominent Beeline features:

- Complete absence of slipping between wire and block.
- Direct block-to-block wire running, with automatic speed control and no loops or other mechanical adjusting devices.
- Continuous speed adjustment from almost zero up to maximum.

Let us help you to solve your problems. We shall be glad to answer your questions promptly. Don't forget to let us know what wire is to be drawn, the inlet and finished diameter, its intended use, the production required, and all other relevant information (tensile strength of the finished wire etc.). Then we can suggest a machine that will be just right for you.

The machine is at present manufactured in three different sizes:

BEELINE DG 5
for heavy wire, about 13 mm. (7/0 SWG)

BEELINE DG 4
for wire rods, about 7 mm. (2 SWG)

BEELINE DG 3
for wire with an inlet diameter of about 3 mm. (11 SWG)

MH

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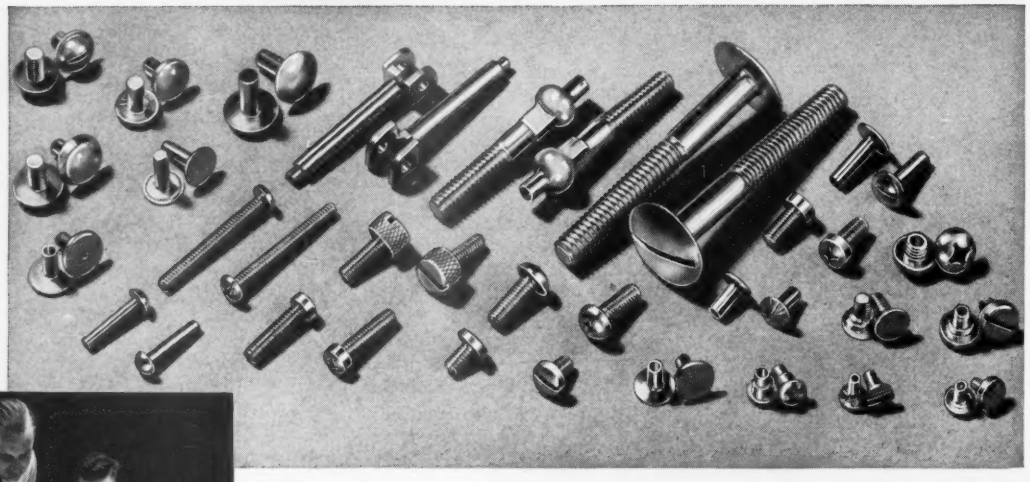

SCOVILL EXTRUDED COLD-HEADING WIRE (Cartridge Brass, 70%)

. . . because of its higher copper content and production by the Hot Extrusion process from uniformly sound Continuous-Cast billets . . . virtually eliminates defects (when attributed to wire) such as split heads or shanks . . . "out of round" heads . . . inadequate filling out of heads and shoulders . . . and rough "orange peel" effect. These are differences in quality you can SELL in your cold-headed products.

Let us help you specify the proper closely controlled Scovill temper to produce more nearly perfect headed parts . . . whether you require "flow" characteristics for heading, or "flow" plus essential rigidity for secondary machining.

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BRASS • BRONZE • NICKEL SILVER • ALUMINUM

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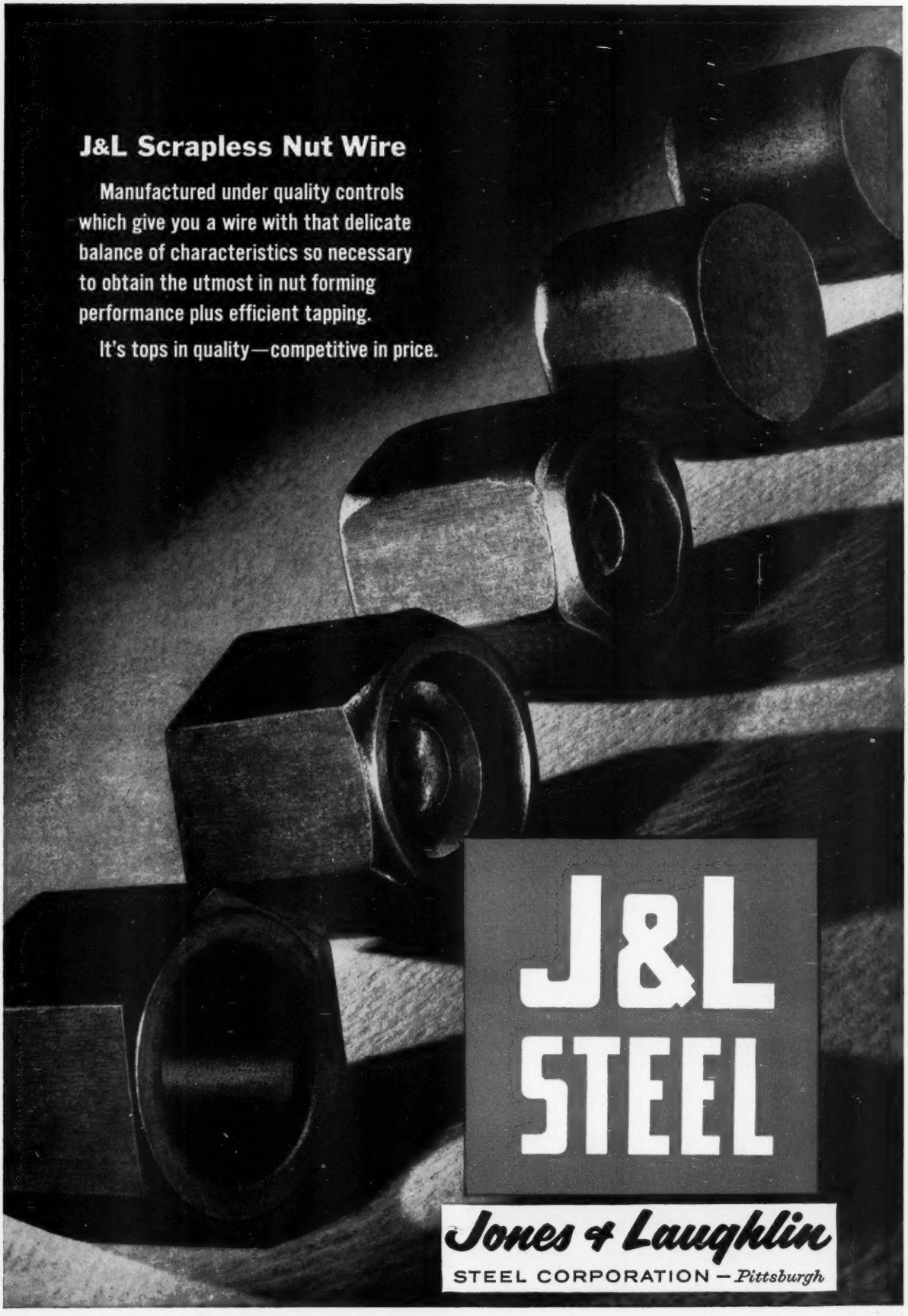
J&L Scrapless Nut Wire
Manufactured under quality controls which give you a wire with that delicate balance of characteristics so necessary to obtain the utmost in nut forming performance plus efficient tapping.
It's tops in quality—competitive in price.
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STEEL
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STEEL CORPORATION — Pittsburgh

How a National-Standard wire development took

A BETTER "REEF" IN BABY'S PANTS

● Almost any product can be made better. Take safety pins.

A prominent manufacturer came to National-Standard with this idea: "Give us," he said, "a polished wire that needs no plating, yet won't corrode... a better, stronger, springier wire to which we can attach a plastic head."

A National-Standard research team took on the problem... and produced a special stainless steel wire with a mirror finish that needed no further polishing. They gave it magnetic properties so that bits of steel could be easily removed from the plastic compound used for heads . . . to protect costly dies and equipment. They gave it a special temper that made it springier, tougher, yet still easy to form.

Thousands of manufacturers have learned to depend on National-Standard for development and manufacture of special types of wire, wire cloth and strip steel . . . fussy, hard-to-make products that many companies hesitate to tackle. Why not give us a call and see what we can do for *you*.

NS NATIONAL-STANDARD Company NILES, MICHIGAN

NATIONAL-STANDARD COMPANY • NILES, MICHIGAN
Tire Wire, Stainless, Fabricated Braids and Tape
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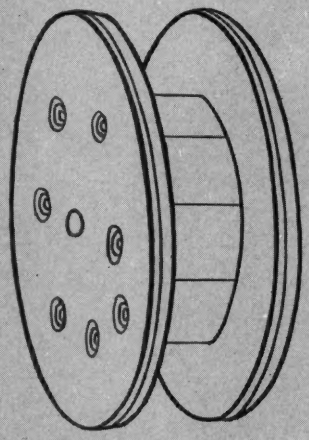


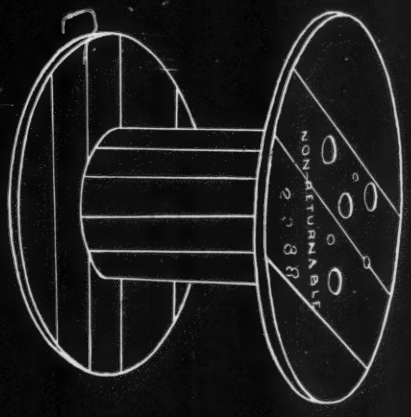
- REQUIRES NO MAINTENANCE
- LIGHT IN WEIGHT
- SUPERIOR SERVICE
- SATISFIED CUSTOMERS

METAL BOUND

NONRETURNABLE

the NARCO NON-RETURNABLE

- AN EXPENDABLE PACKAGE
- LIGHT IN WEIGHT
- SOUNDLY ENGINEERED
- LOW IN COST



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The Wire Outlook

Back in September, 1946, we expressed an editorial opinion on the effect of the government's spending philosophy with respect to the national debt and inflation. It was then stated that "the national debt is too huge to be paid off. . . .

The years of casual, care-free and even wanton extravagance in Washington, in which billions of dollars were strewn about the world with no bearing on our war-winning necessities, have laid the basis for an inflationary adjustment that no hand can stop. . . . Therefore, do not be alarmed unduly—if you find that a car costing $1,000 in 1940 will cost you $3,000 in 1950—your income at that time will be in proportion to the car's price."

It was further pointed out that with each inflationary cycle, after a balance had been attained, the operation would be repeated until the economy had been raised to a point where the national debt had been brought into a reasonable relationship with the national income.

This economic force seems to be functioning and it will continue to operate up to the point of equitable balance between debt and income. Wages, salaries and prices have advanced—and the end is not yet in sight. True, product prices have not advanced in all cases to the degree expected, due to the greater efficiencies in production forced on manufacturers by circumstances.

We are now in an era that is trending toward free-trade, the unfortunate result of which is that it becomes more and more easy for low-cost foreign goods to enter our country and more and more difficult for our manufacturers to sell abroad. We still hold to the theory that while free trade is desirable, duties should be charged that reflect the differences in wage levels and standards of living between our country and others with whom we do business. This would establish a type of free trade in which the competition between products would be based on relative merit alone.

Business opinion now quite generally is that 1956 will be a banner one as to both volume and profits. New highs were set in 1955 in gross national product, national income and personal income. Records were shattered in many key industries including steel, automotive, petroleum, chemical, building and electric power. While business for the year was unprecedented, it is the consensus of the majority that we will charge through 1956 to wind up with another record-smashing year.

Practically every major industry is readying plans for a continuing program of expansion and improvement. As of January 1st our steel ingot capacity was 128,363,000 net tons. This is close to 40% more than in 1945 and an increase of 2% over a year ago.

Prices will edge higher during the year, with the cost-of-living index rising from 115% to 115.2%. The 1947-49 average was 112.4%. The advance will thus be orderly and not too disturbing. Population will keep on growing at a rapid rate and is expected to stand at 170 million by the year's end. Projected growth for 1970 indicates that the 200 million mark will have been passed by then.

The wire industry gives every indication of continuing strong activity. Manufacturers' wire is selling well and a seasonal pick-up in merchant wire product is under way.

Political factions will endeavor to stir up doubts about the soundness of business and the probability of business remaining at high levels. These doomcasters' statements can be discounted, but it is always possible that too much of this sort of thing could create fears that may result in a downslide. Admittedly the soft spot in the economy is the state of the farmers, whose plight is being given much consideration.

Business is sound and it is good. The efforts of the Administration will be to keep it that way.

—from the Editor's Desk

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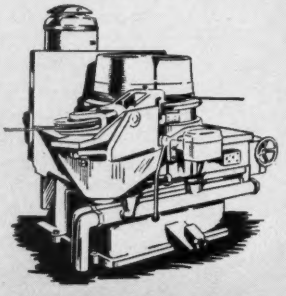

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WIRE AND WIRE PRODUCTS

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DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 31 February, 1956 No. 2

Fracture Studies In America 10,000 Years Ago

by Carl A. Zapffe, Metallurgist
Baltimore, Maryland

This article is somewhat unusual for Wire and Wire Products and, in fact, would be an unusual one for any scientific publication. The subject, however, has a direct connection with the wire industry, for these same fracture conformations of many millenia ago are precisely the ones found on fractured metals and used in fracture analysis.

For those who have not fully realized that certain high stages of truly technical development had been reached by humanity's forbears tens of thousands of years ago, these quotations are reproduced from modern scientists who have made it a matter of experimentation to reproduce prehistoric artifacts. The one was studying the American Indian; the other, both the European and the American traditions. Millions of dollars per year are currently being spent to determine the laws which govern the fracture of materials, yet the humanity of the so-called Stone Age fashioned their tools and weapons by a learned manipulation of those laws, and with achievements which could only be reproduced today, if at all, after extensive training. Flint razors have been found from ancient times which still cut; and the story is both interesting and instructive.

"The best examples of the flaking-work of the primitive stone-worker are marvels of craftsmanship. They are the result of exceptional skill, the lessons learned and handed down by a long line of stone-working ancestors, and years of practice and experience in flaking stone and making stone implements. A number of secrets of technique of the Stone Age still await discovery, and the modern flaker can only view with respect and admiration the work of the ancient master."

—From F. H. S. Knowles on *Manufacture of a Flint Arrow-head* (1944)

★ ★ ★

"It is only after we have tried to do this on such stones as quartz or argillite that we fully appreciate the amazing skill of our copper-hued friends. In fact, the chipping or flaking of stone can easily be considered a science in itself."

—From J. A. Branegan on *Chemistry and Science in Prehistoric America* (1925)

Stone Age Man

In ancient Greece, Hesiod described the concept of human culture advancing from a Stone Age to a Bronze Age to an Iron Age, and this was later repeated by Lucretius in Italy. Nevertheless, when prehistoric implements were accidently unearthed, they were usually called "thunderstones" or "elf stones"; and their technical explanation was likely to be in the terms of medieval Tollius:

" . . . generated in the sky by a fulgurous exhalation conglobed in a cloud by the circumposed humour . . . ! "

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Late in the Sixteenth Century, Michael Mercati proposed that "thunderstones" were implements of primitive man; and in 1690 the fact became known that a flint spear point had been found associated with an elephant's tooth in a gravel bed near London.

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Nevertheless, it was still conventional in those times to think of Creation as having begun in the year 4004 B.C. It was not until the Nineteenth Century that the Danish archeologist, Christien Thomsen, revived Hesiod's concept on the basis of stratified finds in Denmark peat. Two years later, Jacques de Perthes found flint implements interbedded with skeletons of an extinct mammoth along the Somme River near Abbeville, France. His publication in 1839 claimed an antediluvian origin; and he was much ridiculed and criticized for some years, until the English geologists Falconer and Prestwich visited the locale and confirmed the discovery.

Periods and Cultures of Stone Age Man

By Stone Age, no fixed chronological epoch is meant, but rather a cultural stage of a people or an ethnic unit unacquainted with the working of metal. Some are still in their Stone Age, as the Kukukuku Tribe along the Watut River in New Guinea; and others have only recently left the Stone Age, witness the American Indian.

On the other hand, the current status of archeological and anthropological finds does permit a general chronology on a world-wide basis, as indicated in the accompanying Table. Here are shown the approximate historical relationships according to the best current estimates in the fields of archeology, anthropology, and geology or glaciology. The fourth column is an epitome of certain theological descriptions which were recently used in deriving a new theory for the Great Ice Ages (see the October 1954 issue of *Physics Today*). The chart thus relates the several principal anthropological types with the archeologist's cultures, and these in turn with the several great glacial stages. The most primitive forms of lithic workmanship are termed *eoliths*, the prefix *eo-* being taken from the Greek word for "dawn". The eolith is the basic form from which all later flint implements derive; and apparently even *Australopithecus*—at the very top of the chart—used crude weapons and tools of this sort.

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Accordingly, the Eolithic Period or "Dawn of the Stone Age" stands at the threshold of human history and at the head of the archeological chronology. Possibly it penetrates the Pliocene Epoch of geology, some striking finds having been reported for a Pliocene stratum in the Weald of Kent, England; and claims have even been made for eoliths found in Upper Miocene gravel beds of the Cantal in France, thus possibly reaching to 10,000,000 B.C.

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Forward in time, the Eolithic Period extends to the onset of recognizable cultures, the first generally being accepted as the Chellean, as found at Chelles, France. Just as geology speaks of a Pre-Cambrian division of earth history, broadly including all stratigraphy prior to that containing the first fossiliferous forms, so does archeology speak of a "Pre-Chellean" culture or age. The Villafranchian is one, identified stratigraphically with the First or Nebraskan Glacial Stage, hence having an age of the order of a million years, more or less. Two other finds, the Abbevillian and the Clactonian, have been related to the start and the close, respectively, of the Aftonian Interglacial Age.

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Over long periods of time, the primitive eoliths of pointed or triangular form evolved to what have been called "rostro-carinate" implements, so named from the keel or ridge forming down the center when flaked from both sides. This in turn culminated in the *coup de poing* or hand ax, a rhomboidal instrument whose appearance introduces the Chellean Culture and the Paleolithic Period. The tabulation shows the Chellean Culture to correspond roughly with the controversial Piltdown Man—whose hoaxed parts only recently were submitted to detection and analysis—and perhaps the earlier reaches of Neanderthal Man.

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Thereafter the controlled fracturing of stones to produce useful implements attained the status of what can truly be called a technology. The Acheulean Culture is characterized by flints which are "flaked" over the entire surface to produce such tools as scrapers, awls, and planers. Refinements in "toughening" or shaping the edges

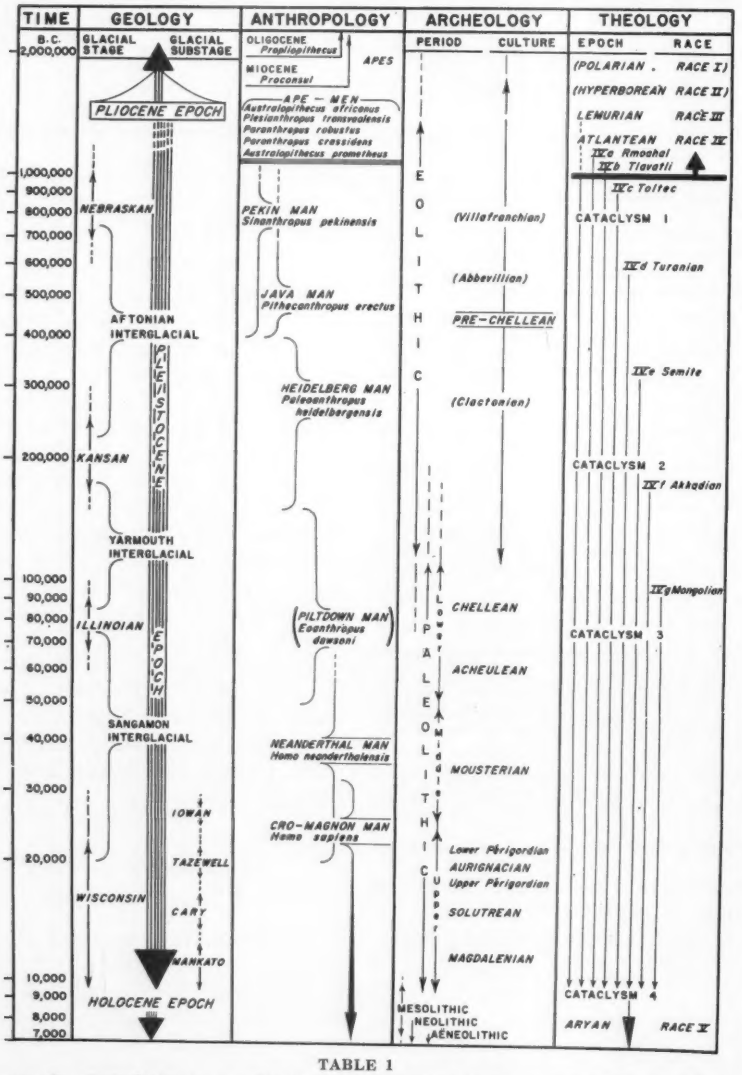

TABLE 1

Comparative chronologies for so-called Stone Age Mankind from the standpoints of geology, anthropology, archeology, and theology. The column on the left shows the four great Ice Ages with their interglacial stages covering the past 1,000,000 years, which is the Pleistocene Epoch in geology. The second column lists the several principal finds of human relics with their age ranges according to best current estimates. The third column outlines the archeological story of periods and cultures. The last column contains some descriptions from esoteric theology which are believed to have peculiar significance to glaciological theory and the origin of Man. (See October 1954 issue of "Physics Today.") * * * * * * *

of cutting instruments can be traced through various stages of development. A "resolved" or "step flaking" produced by inward blows left a ridge or keel at the fracture junctions. Next, a "feather-edge flaking" produced by diagonal outward blows near the edge left a sharp angle with the surface, Finally, "pressure-flaking" — producing minute edge flakes by compression instead of percussion—led to the development of the razor-sharp blades mentioned in the introduction. These several developments progressively gave rise to the cultures of the Middle and Upper Paleolithic Subperiods. At the time of the Upper Paleolithic, Cro-Magnon Man had made his appearance, the Aurignacian Culture being outstanding for its "cave art", bone and ivory implements, and blade-type tools, the "beaked burin" reaching a technical climax for that form of tool. The following Solutrean Culture developed shouldered and laurel-leaf points which have scarcely if ever been surpassed. The Magdalenian Culture closed the Paleolithic Period about 10,000 B.C. with the Mankato Maximum of the Wisconsin glacial stage. The humanity of that time was *Homo sapiens,* the principal anthropological type being Cro-Magnon Man, although it must not be supposed that his was the only Race extant at that time. His lithic implements included scrapers of side-, end-, core-, and round types; awls, and pseudo-awls with the point trimmed only hemispherically; points ranging from delicate darts to lance heads; arrowheads of wing, tang, wing-and-tang, lozenge and other designs; "pigmy tools" identified as lunates, crescents, triangles, trapezes, and so forth, according to shape. Flint was even fashioned into saws of surprising utility. The cave art reached an unsurpassed height, insofar as yet known; bone, antler, and ivory came in for much working; and finally, grinding and polishing became added to the flaking techniques. This allowed a broadening of the useful materials to include such rocks as diorite; and stone celts or adzes recovered from Lake Zurich at Meilen even today have an edge keen enough to sharpen a pencil.

Flint and "Flaking"

Comparable to the discovery of fire and the invention of the wheel is this art and technology of *flaking*—an archeologist's term for a special type of chip formation, and not to be confused with the metallurgist's use of the same word for an entirely different phenomenon. Only certain stones display characteristics suitable for flaking, the best being the concretionary varieties of quartz: flint, chert, jasper, and so forth; and of these, flint is the classic example. Flint is a variably hydrated silicate with a hardness greater than that of steel. When pure it is translucent; but impurities render it opaque and colored, commonly either black or brown. Its origin is not yet precisely known. Typically found in beds of chalk or limestone, the nodules usually exhibit concretionary growth, and they frequently disclose relationships to marine organisms of an overlying sea in geologically remote times. The fracture of flint is conchoidal, and its susceptibility to fracture has a surprising range, principally depending upon moisture content. This fractological factor was surprisingly well understood by the men of ancient times.

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To illustrate the constancy of the Laws of Nature over a period of many thousands of years, Figure 1 compares some fracture forms of modern glass with flint flakes belonging to a North American culture far antecedent to the historical Indian. The arrows point to the *focus* or impacting point. Because of the characteristic convexity of such focal areas, archeologists refer to this as the "bulb of percussion". It is particularly evident in one of the glass chips and in one of the flint flakes. According to the new fracture terminology developed by the present writer and his associates, this fractographic configuration is designated *focal* and indexed *IIa.* A second common characteristic is the undulation developing in the traverse as it proceeds from the focus. Previously given many names by different investigators, these undulations are now termed *peripheral* because they record transient peripheries of the fracture; and they are indexed *IIb.* They can be seen on all four specimens. Finally, the lower pair discloses some fine markings approximately normal to *IIb* and representing *conjunctures* of laterally displaced subelements of the fracture. They are indexed *IIc.* The history of all four of these fractures is accordingly contained in their patterns, allowing one to reconstruct even minute details of operations performed by Stone Age men thousands of years ago.

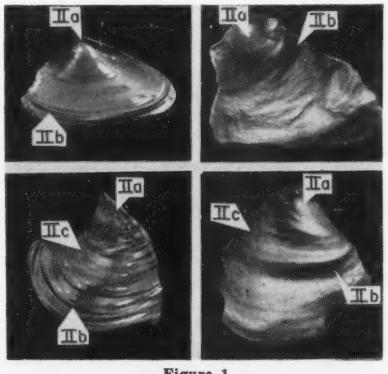

Figure 1
Comparison of fractures separated thousands of years in time. The specimens on the left are chips of modern plate glass, while those on the right are flakes of flint made by Stone Age Man in America long before the historical period of the American Indian. Each of the specimens has a plainly marked focus, indexed IIa, the upper two showing similar "bulbs of percussion". Peripheral undulations, indexed IIb, similarly appear on each, and these record the precise progress of the fracture. The glass and flint pair at the bottom of the Figure also show identical conjunctural traces, indexed IIc, which record the joining of minute fractural elements which are slightly displaced stratigraphically. 4X * *

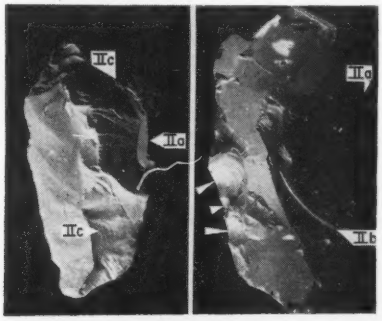

Figure 2
Roughly worked prehistoric scraper made from an impure type of flint. The obverse face at the left shows a clear focus at IIa, recording a blow struck inward in an attempt to sharpen the edge, but leaving an undesirable platform. Conjunctures proceeding from this focus, an example being indicated by the IIc arrow, show the approximate direction of the fracture. Another conjunctural family at bottom-center records a blow struck downward from the keel. The reverse face on the right shows a major fracture proceeding from IIa with prominent IIb traces. On the left a number of smaller flakes were struck to sharpen the edge described in the matching view. 2X * * * * * * *

In Figure 2, obverse and reverse sides of a prehistoric North American tool, probably a scraper, carry a full record of its stages of production. Unlike the two flint arti-

facts just shown, which reveal little or no working beyond the formation of the flake itself, the specimen in Figure 2 has an intelligent design of at least rough sort. The *Ha* arrow on the obverse face points to the focus of a flake intended to produce an edge on the tool; and the reverse face similarly shows a large flake designed for sharpening the opposite edge. A keel has resulted in both cases, and secondary flaking to reduce that prominence is clearly evident. The various directions in which these blows were struck are recorded principally by conjunctural traces on the obverse face, and by peripheral traces on the reverse.

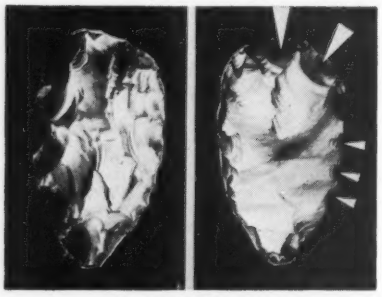

Figure 3

Elaborately worked prehistoric flint scraper. The flint is more pure than that in the preceding Figure, and the flaking much more precise. The obverse face on the left shows a completely flaked surface, excellent symmetry, and focal detail which lends to great sharpness of edge. The reverse face on the right reveals that the tool has been made from a flake rather than from a core, the large arrows indicating blows struck for the purpose of removing the focal bulb. Lesser arrows designate minute and carefully produced flakes in an edge-sharpening operation which was likely performed by pressure rather than by impact. 2X

In Figure 3, a much more refined workmanship is evident. The material is a good grade of flint, whereas the preceding specimen was a chert. The symmetry of the tool is excellent, and nearly the entire surface has been worked. The reverse face discloses that the tool has been made from a flake itself, the larger arrows at the top designating impacts made to remove the "bulb" of the original flake. The lesser arrows along the sides point to a large number of minute flakes whose skillfully controlled size and placement probably identify an operation of "pressure flaking".

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Flaking can be produced by (1) percussion, (2) pressure, and (3) thermal change. The first is generally presumed to have opened the Stone Age technology; and there are three great flaking traditions: (a) *Core,* in which flakes are detached from a core, (b) *flake,* in which the flake itself is used as a tool, and (c) *blade,* in which a flake is especially shaped before detaching from a core. That is, the order of developing a flint implement is first to obtain a "quarter" or "core" as a working piece broken from a nodule. The chipping or controlled fracturing of this core produces a flake, and upon the numerous techniques of this flaking the entire lithic technology depends.

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As for pressure flaking, the first evidence for it appears from 10 to 20 thousand years ago in the Solutrean culture. The method is still in use by primitive peoples, such as the aborigines of Australia. These have been seen to use the sole of the foot as an anvil with a bone tool especially adapted for pressing minute flakes off the edge to be sharpened. Torquemada in 1615 found the Aztecs fashioning flakes of obsidian in this manner; and Captain John Smith, a few years earlier, wrote of the Indian in Virginia:

" . . . his arrowhead he maketh quickly with a little bone . . . of any flint or glasse in the form of a heart, and these they glew to the ends of their arrows . . . "

The Navajo and Shoshone Indians retain the practice today.

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In Figure 4, the entire procedure is shown schematically. The operation begins with a flint block or nodule and a "hammer-stone" such as oval water-worn pebbles of quartzite. Knowles has described operations in which a three-pound size was used for breaking the original flint nodule into pieces suitable as cores; stones weighing from 1 to 2 pounds were then used for removing the working flake from the core; and, finally, pebbles

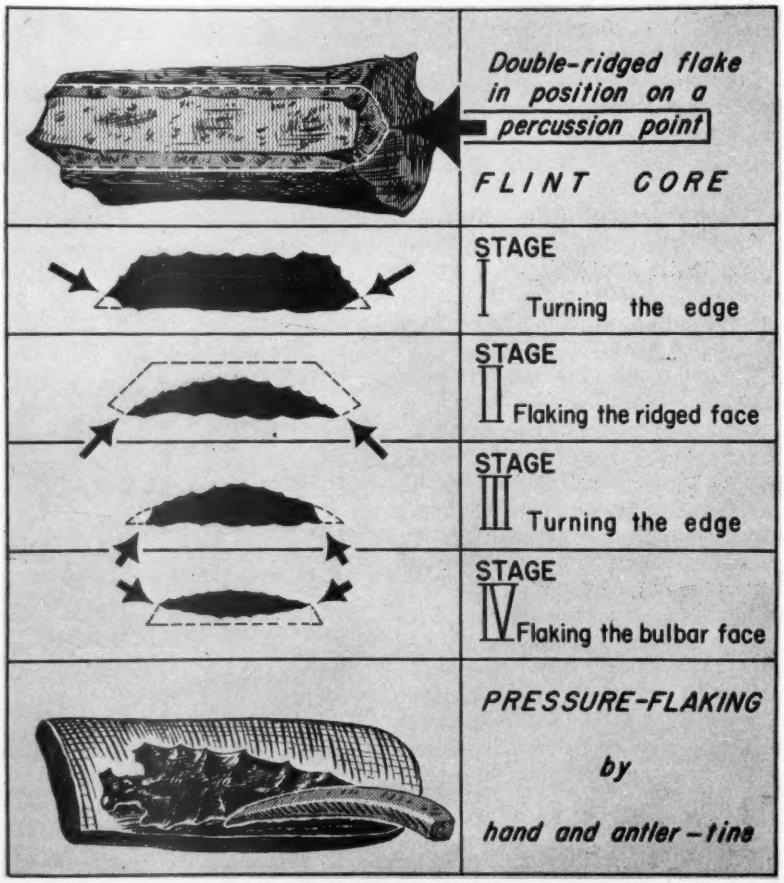

Figure 4

Stages in preparing an arrowhead according to Knowles. Beginning with a carefully selected flint core, the worker detaches a large flake which is then in turn flaked by the fine-scale operations of Stages I, II, III, and IV. The edge is finished by pressure-flaking with a bone or antler tine. Redrawn from Pitt Rivers Museum Paper No. 1: "Manufacture of a Flint Arrowhead".

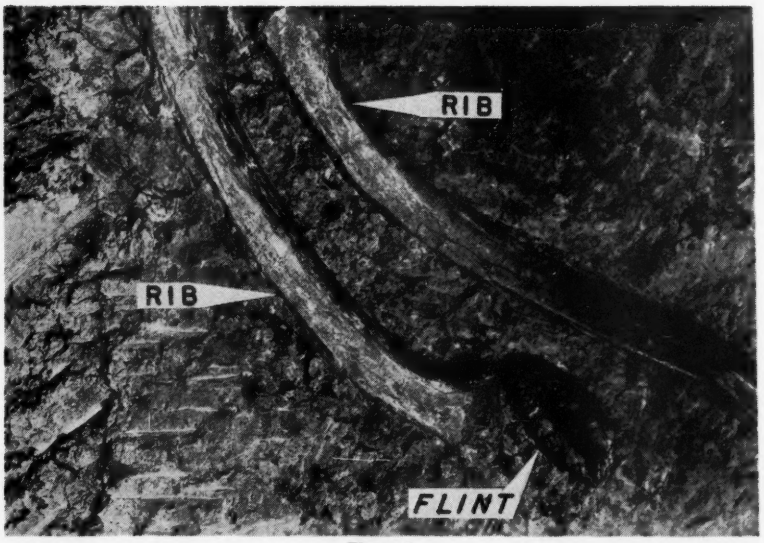

Figure 5
The original Folsom find. This is a photograph, as excavated, of a pair of rib bones from an extinct bison, between which is lodged a specially fluted projectile point characteristic of Folsom Man. (Courtesy of F. H. H. Roberts and the "Scientific American".) * * * *

weighing only a few ounces were used for flaking this flake in turn to produce the roughly finished artifact. An antler tine served for working the edge by the method of pressure flaking.

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Although the procedures may appear simple, they are quite complex. First, it is necessary to strike the core at a precisely located spot in order to detach a flake of the desired dimensions; second, the force of the blow must be regulated since this also has a relationship to flake dimensions; and third, similar to many forms of athletic contests, the operator must "follow through" with the blow instead of following the natural inclination to warp the impacting force toward the operator. Failure here will cause the flake to break out before traversing the entire length of the core. The desirable flake features are: (a) Regular width, (b) approximately uniform thickness throughout most of the length, and (c) a percussion bulb which has either been flattened by a secondary chip formation called an *éraillure,* or has a natural flatness. These prerequisites then have the difficulty further increased by heterogeneous features of the flint. The careful artisan finds preferential positions of the flint block for removing the core, preferential positions of the core for removing the flake, and even preferential positions of the flake for removing the cross-flakes. Again, in such operations as "turning the edge" in Stages I and II of Figure 4, to produce what the archeologist calls a "faceted platform", the angle of this platform must be carefully chosen. If too narrow, irregular flaking results; if too wide, the final width of the arrowhead will be correspondingly reduced.

Prehistoric Man in North America

Since Columbus discovered the New World, the history of the American Indians has been a subject of much discussion, and their origin a matter of wide speculation. The notable absence of any trace of either primitive man or of the great apes on the American Continent, at least so far as yet known, has quite naturally given rise to a belief that the Indian races did not originate in America, but immigrated instead from some other continent. An unrestricted latitude of opinion has arisen, variously identifying the American Indian with Carthaginian or Phoenician voyageurs of ancient times, with the Lost Tribes of Israel, with the Lost Continent of Atlantis, with the Israelitic immigration described in the book of Mormon, and with a presumed Asiatic immigration taking place across the Behring Straits. This last is currently the choice of most scientists; nevertheless, the only point of universal agreement rests with those numerous ethnic traits, both physical and cultural, which are mutual to Asiatic and American Indians alike.

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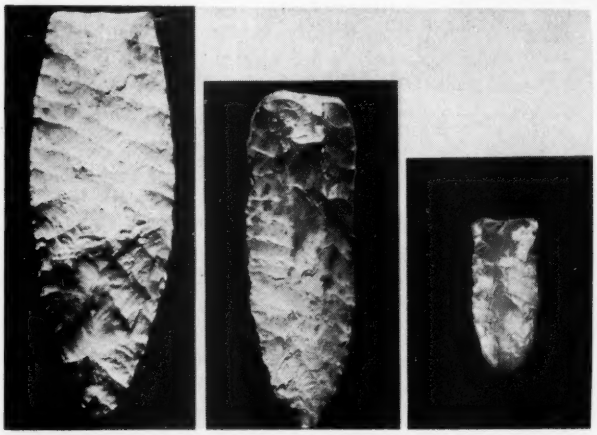
Only in recent years has archeology made any important progress with regard to this mystery, though currently at a greatly increasing tempo. The principal advances began in 1926 with two great discoveries in the Southwest. One was a find near Folsom, New



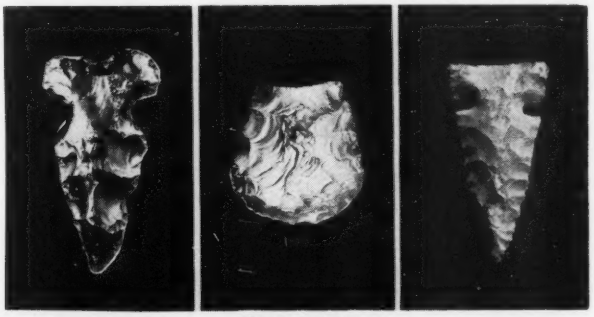


Figure 6 (left)
Prehistoric points from the Yuma Complex. 2X * * * * *

Figure 7 (above)
Examples of carefully worked lithic implements of various types and materials made by Stone Age men in America. The specimen on the left is an arrowhead made of obsidian; the one in the center is a flint tool; and on the right is a flint arrowhead. 2X * * * * * *

Mexico, disclosing lithic tools in association with bones of an extinct bison. The second was a find in Cochise County, Arizona, where stone implements lay near the skull of a mammoth. This latter site was neglected for nearly a decade; but the Folsom Site was further excavated in 1927 with results which put the fact of prehistoric American Man on a firm basis. Artifacts of Folsom Culture have since been found widely dispersed over the great Western Plains region from Alberta and Saskatchewan down to Mexico, also as far East as Ontario.

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In Figure 5, a photograph of the original Folsom Site shows two rib bones of an extinct bison with a flint projectile point lodged between them. An unusual longitudinal channel, negative in sense to the keel which commonly characterizes flaked points, has produced what is called a "fluted" point, now a characteristic of the classic Folsom type, and apparently without duplication elsewhere in the world so far as now known. The Folsom implements were often also further finished by careful edge-flaking. As for their dating, they are commonly found in deposits formed at the close of the last Ice Age. Libby has published radiocarbon analyses of bone associated with these finds, giving an age of approximately 8000 B.C.

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Shortly after the Folsom discovery, an important industry was uncovered in Yuma County, Colorado. Some typical specimens are shown in Figure 6. The point at the left is heavily patinated, the one in the center is partially so, whereas the small point at the right is in an excellent state of preservation. All are outstanding for their long and thin flakes which often entirely remove the effects of either a positive or negative keel. The symmetry is also good. Libby has dated Yuma remains near 6000 B.C.

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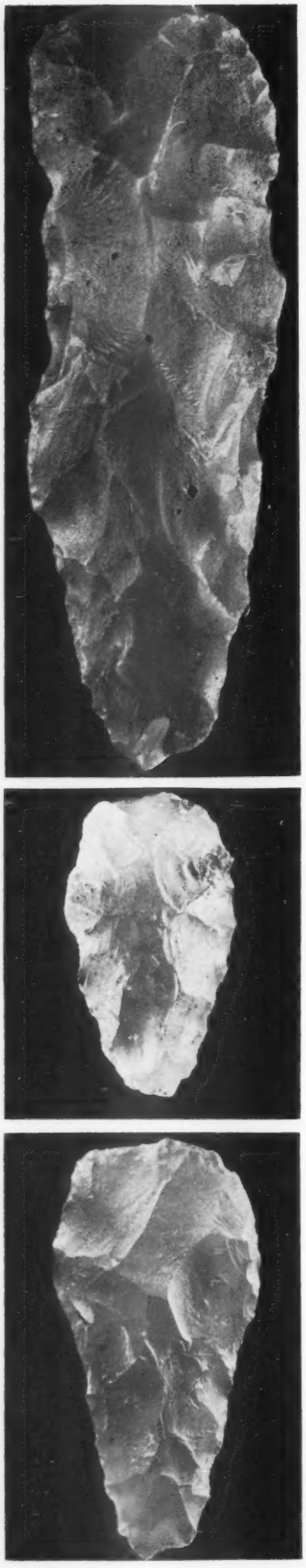

Figure 8
Points from an unidentified prehistoric American Culture. These striking artifacts belong to a Late-Neolithic industry of the western United States whose dating and Culture have not yet been determined. 2X

Other Post-Folsom artifacts and industries are currently being reported in increasing number. Woven rope sandals from a cave in Oregon have been placed by radiocarbon dating at approximately 7000 B.C., hence almost contemporaneous with the Folsom Culture. More recent is the Lamoka Culture, dated at approximately 2500 B.C. This Culture is apparently related to the puzzling Dorset Culture whose traces have been found in northeastern parts of North America. The Dorsets were previously believed to be an Early or Pre-Eskimo Culture with origins in the North or Northwest; but recent indications are that the migration was from southern parts, more or less following the retreat of the ice sheet.

★ ★ ★

Figure 7 shows some examples of these later Neolithic industries. The arrowhead on the left has been fashioned from obsidian, the ones on the right from flint. The workmanship is good on the obsidian, considering that it is far less susceptible to controlled flaking than is flint, whereas the delicate artisanry of the specimen on the right would take a modern student a long time to reproduce. The artifact in the center is a fragment, probably the end of a drill. The surface is completely flaked to produce fine symmetry, evenly graded thickness, and a sharp edge.

★ ★ ★

In Figure 8, several specimens corresponding to the Pinto-Basin industries of Southern California, also the Lake Mojave finds in the Mojave Desert, are particularly striking for the translucency of the material and the excellent preservation of surface detail. There is a slight keel structure in these points, in contrast to the leveled surfaces of the Yuma points in Figure 6.

★ ★ ★

Several discoveries are apparently under development which show that the laws of fracture have been studied by North Americans even prior to the time of Folsom Man. Tepexpán Man in Mexico has had radiocarbon datings ranging back

(*Please turn to page* 243)

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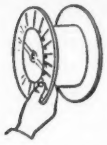

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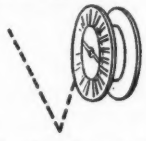

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Manufacture of Aluminum Conductor Telephone Cable

by James S. Herbert
Engineer—Wire Drawing, Insulating and Twisting
Western Electric Company
Kearny, New Jersey

This paper was delivered at the Third Annual Wire and Cable Symposium sponsored by the Signal Corps Engineering Laboratories on December 8, 1954, at Asbury Park, N. J. It is printed with the permission of the author and his company.

The development of aluminum conductor exchange area telephone cable (used for local circuits) was started at the **Western Electric Company Works** in Kearny, N. J. early in 1949 in conjunction with the **Bell Telephone Laboratories** to exploit the advantages of aluminum as a conductor material. Compared to copper, the usual metallic conductor for electrical systems, aluminum will give equal conductivity in one half the weight. Since the price per pound is greater for copper there would be a substantial saving in the cable cost with this weight reduction. However, to obtain equivalent conductivity in aluminum it is necessary to increase the cross-sectional area of the wire approximately 60% over that required in copper. In the case of exchange cable, this means there will be a substantial increase in the amounts of insulating and sheathing material required that will decrease the initial cost advantage.

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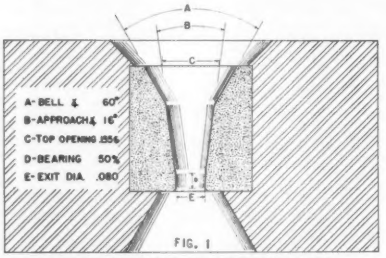
In December, 1951, there was a shortage of copper for Bell System requirements due to the National Emergency and the aluminum conductor development program was extended to the Hawthorne Works in Chicago to accelerate production. The cable manufacturing machinery at both of these locations was designed and installed for processing copper conductors. The difference in physical properties of aluminum necessitated a review of the entire operation to determine the required modifications and additions. A summary of the engineering, production, and operating results of this development is given in this paper.

Wire Drawing

The wire drawing facilities installed at Kearny for processing copper exchange cable conductors consist of four No. 1 rod breakdown machines and fourteen 10,000 feet per minute No. 2 wire finishing machines. To maintain optimum performance when drawing aluminum on this equipment it was necessary to equip a breakdown machine with pulling capstans of a diameter that would have minimum slip on the wire. Since aluminum rod is commercially available in 3/8″ diameter, instead of 5/16″ for copper, the die set for the No. 1 machine was resized. The ten die steps in this machine reduce the 3/8″ aluminum supply rod to 12 gage (.080″) supply wire for the No. 2 machines instead of the 5/16″ diameter to 14 gage (.064″) reduction used for copper. The first nine dies of this set are tungsten carbide and the finisher die is a diamond to maintain closer diameter control over an extended period. The shape of the dies used and a table of their dimensions are shown in Figures 1 and 2. To determine the minimum slip between the wire and the capstans necessary to maintain the most favorable relationship of die pull to breaking strength, a series of tests were run on various combinations of die openings and the results are shown in Figures 3 and 4. From this data the capstan diameters were adjusted to obtain the desired operating characteristics. Wire breaks on the rod machine are less than for copper and average .073 breaks per equivalent 1,000 lbs. for aluminum compared to .082 breaks per 1,000 lbs. of copper. We have noted that the die sets used for aluminum show very little wear and to date have drawn three million pounds of this material. However, we have established a practice of polishing the dies after drawing approximately 100,000 lbs. of aluminum wire to eliminate the possibility of seizure and wire breaks. While the Hawthorne Plant has different design wire drawing equipment the engineering approach and results obtained were virtually the same. The No. 2 wire drawing machines are equipped with diamond dies and require all twelve die steps to obtain a reduction from 12 to 24 gage. To obtain a wire size of 22, 20 or 17 gage the last dies in this series are removed and the whole set moved forward to fill open die positions so the 10,000 feet per minute finishing speed is main-



TYPICAL TUNGSTEN CARBIDE DRAWING DIE
ALUMINUM

FIG. 2

TUNGSTEN CARBIDE DRAWING DIES
ALUMINUM

Die Size		.375	.257	.220	.188	.162	.141	.120	.105	.092	.080
Bearing length	Percent of Wire Diameter	30	35	38	40	43	45	46	48	49	50
	Actual	.0975	.0900	.0836	.0752	.0697	.0634	.0557	.0504	.0451	.0385
Approach Angle		25°	25°	20°	18°	16°	16°	16°	16°	16°	16°
Top Opening		.5344	.4698	.3914	.3446	.3032	.2832	.2646	.1750	.1636	.1556

FIG. 3

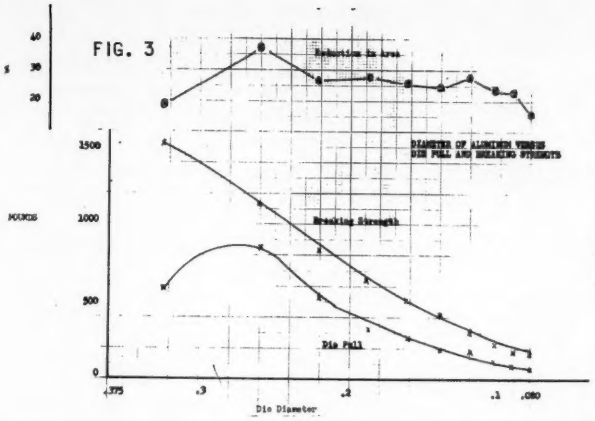
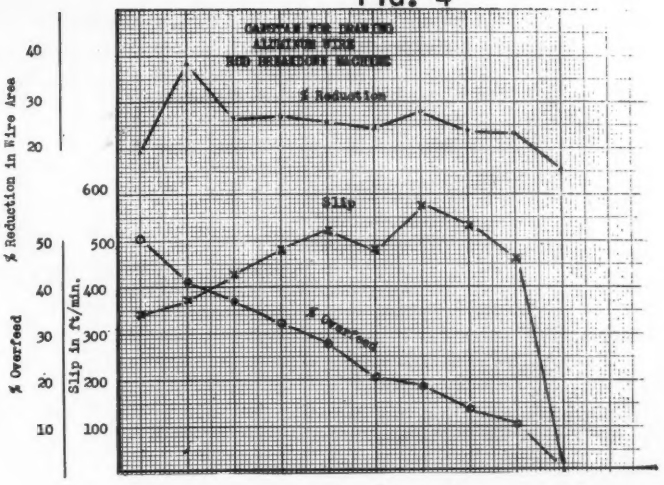


FIG. 4



DESIGN FORMULAS

$$\text{Area} = \frac{\pi d^2}{4} = .7854\, d^2$$

$$\%\ \text{Reduction in Wire Area} = \frac{\text{Entering Area} - \text{Exit Area}}{\text{Entering Area}} \times 100$$

Capstan Surface Velocity = Capstan Diameter x π x RPM

Wire Surface Velocity = Capstan Surface Velocity at Last Step

Volume Delivery = Area of Wire x Surface Velocity

Slip = Capstan Surface Velocity - Wire Velocity

$$\%\ \text{Overfeed} = \frac{\text{Capstan Volume Delivery} - \text{Wire Volume Delivery}}{\text{Capstan Volume Delivery}} \times 100$$

tained regardless of the wire diameter. After some experimentation on the No. 2 machines, we found that it was necessary to replace the underload relay to permit lighter tension adjustments or the spooling was too tight to permit uniform unwinding. We have noted that on this machine less wire breaks are also experienced when drawing aluminum. These average 0.45 breaks per 1,000 lbs. as compared to 0.55 for copper. The lubrication problems associated with drawing aluminum are different than with copper. It was found that the die lubricant must be very good in the breakdown machines to prevent low temperature seizure of the aluminum to the capstans and dies. For this reason it was necessary to use mineral oil for aluminum instead of the fat base water soluble compound used for copper where it is necessary to dissipate much larger quantities of heat. With the introduction of this new compound we are faced with another problem due to the affinity of the lubrication oil for aluminum. It was found that the cork wipers previously used were not adequate to prevent excessive quantities of oil being carried into the machine take-up compartment, and it was necessary to install a sizing die in place of the wiper. Our early investigations indicated the necessity of installing separate compound systems for drawing aluminum to eliminate copper contamination and this was done for both the No. 1 and No. 2 machines. In the case of the No. 1 machines it also segregated the two different compounds that are not the least bit compatible. Our study of different types of drawing compounds for aluminum wire is continuing with a view toward improved operation. We are currently investigating a water soluble oil solution that would be more desirable due to the improved cleanliness and the compatibility between this and the copper compounds. While our initial attempts at drawing aluminum with our present water soluble compound on the No. 1 machine were not successful, we were able to use an identical water soluble fat and soap base lubricant for either metal on the No. 2 machines and have continued to operate in this manner. Our Hawthorne Works, however, is using a light mineral oil. Since our drawing defect rate for aluminum is very low on our No. 2 machines, we do not plan to discontinue the use of our standard compound in favor of the mineral oil. The compound system installations are arranged to permit change-over of these machines from aluminum to copper on an individual basis by means of three-way valves depending on the production requirements. We have found that the compound operating temperatures for optimum performance are between 135° to 145°F.

★ ★ ★

Aluminum wire at Kearny is annealed in an electric bell type furnace on a batch basis after it has been drawn to final size from the initial H-12 rod temper. It was not necessary to make any modification in our annealing facilities, but the temperature is reduced to 390°F instead of 500°F used for copper. The annealing cycle is essentially the same for either metal. The first aluminum conductor cables were made from wire annealed dead soft (30% elongation), but it was found that the tensile strength of this wire was insufficient to permit satisfactory operation of the insulating machines. Graphs of temperature versus resistivity, elongation and the strength are shown in Figure 5. The Bell Telephone Laboratories conducted tests to determine the ductility required for field uses. This ductility is equivalent to 10% elongation of test samples, but since some difficulty was experienced when welding wire that approached this lower limit, we ad-

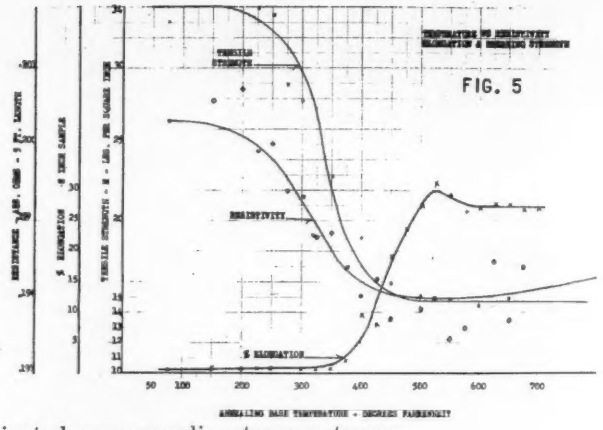


FIG. 5

justed our annealing temperatures to maintain the elongation in the range of 15 to 25%. Following this procedure we feel that the optimum performance characteristics are attained.

PULP INSULATING MACHINE

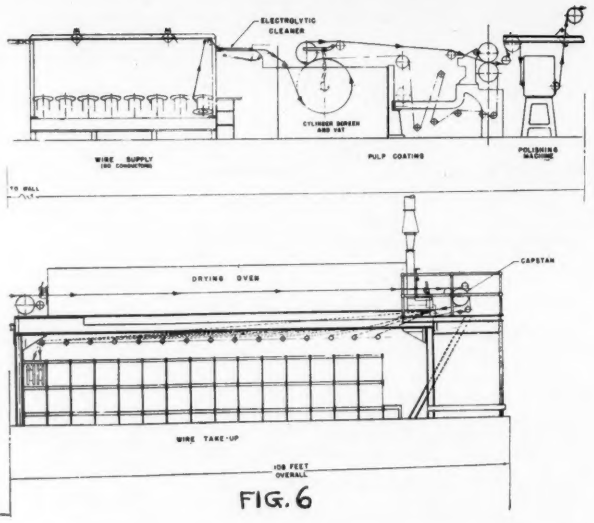


FIG. 6

Pulp Insulating

The process of insulating exchange cable conductors with pulp consists of forming a pulp ribbon on the conductor, polishing this ribbon into a cylinder around the conductor, drying the insulated conductor in an electric furnace, and then winding up the insulated conductor on a take-up reel. A schematic drawing of this 60 wire machine is shown in Figure 6. The forming of pulp ribbon as the wire moves in the vat on a rotating cylinder screen mold is the same as for copper and there were no changes necessary in the method of preparing the pulp. However, it was necessary to make changes in the operating tensions and modify the other phases of the operation performed in this machine. The supply reel flyer arms used to pay out the bare copper wire were satisfactory for the 17 and 20 gage aluminum, but for the lighter 22 and 24 gages it was necessary to provide a counterbalanced flyer arm to obtain a lower and more even tension. The electrolytic cleaner used to remove the wire drawing compound from the conductors before they enter the pulp insulating vat did not work satisfactorily with the copper cleaning compound. Consequently, we experienced excessive cylinder screen clogging and poor ribbon formation on our early trials. In addition to the poor performance of this cleaning compound, further experiments showed that the alkalinity of the sodium orthosilicate solution could contribute to the corrosion of aluminum conductors. This cleaning solution was replaced by an Oakite compound which forms very little precipitate with the aluminum and gives satisfactory cleaning at a solution temperature of 180°F. The pulp machine vat changes consisted of changing the cylinder screen from bronze to stainless steel to eliminate the possibility of corrosion and revising the pulp flow pattern to eliminate lumpy insulation while depositing approximately 35% greater volume of pulp to the 20 gage aluminum conductors. To reduce vibration in the polishing machine, which forms the pulp ribbon into a cylinder around the wire, the center and end polishing blocks were provided with a groove to minimize conductor breaks due to this flexing. This additional vibration experienced with aluminum was attributed mainly to the reduction in the capstan overdrive and tension at the take-up compensator to minimize tension failures in the drying oven. Electric drying ovens are operated at approximately the same temperatures for aluminum as for copper with the first, second and third zones at 1450°, 1350° and 1000°F respectively. These high temperatures create a problem during start-up when the wire is bare, but are overcome when the wet pulp is around the conductor. Since the bare aluminum wire melts at 1200°F compared to the 2000°F for copper, it was necessary to install air lines so that during start-up a blast of air could be fed to the furnace creating a lower temperature without excessive cooling of the furnace walls. To withstand the heat in the oven and at the same time protect the lower floor coils these ovens are equipped with nichrome hearthplates. However, when insulating aluminum wire, ends sometimes fall on the hearthplates and the molten aluminum

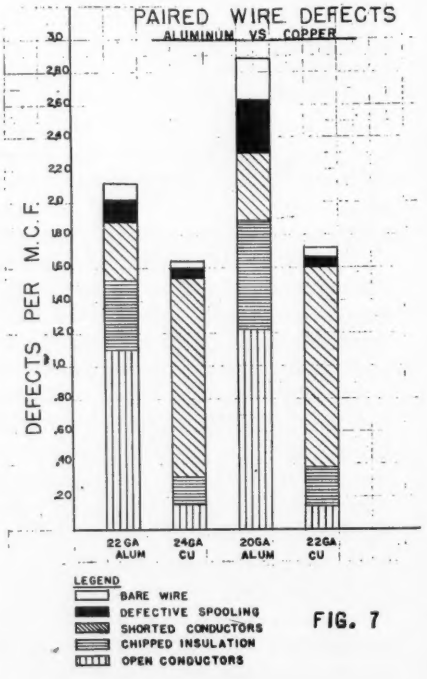


FIG. 7

alloys with the nickel reducing the heat transmission which causes overheating of the floor coils. In an attempt to minimize this problem we have installed carborundum ceramic hearthplates which have proved satisfactory during the last six months of operation. In the early stages of the aluminum development program, we noted some corrosion on individual conductors that was caused by excessive moisture in the pulp insulation adjacent to the steel hub and flanges of the take-up reels. After the cause was detected the investigation was continued in conjunction with the Bell Telephone Laboratories to determine the maximum moisture content to insure corrosion free conductors. It was found that with 15% moisture in the pulp, or 85% relative humidity, corrosion was inevitable and at 12% moisture in the pulp the chances of corrosion were remote. As an added precaution we established 10% or 60% relative humidity as the upper limit and have not experienced any difficulty since.

Twisting

Before the individual conductors insulated at the pulp machines can be put into an exchange cable, they must be twisted into pairs of different twist lengths to minimize cross talk in a completed cable. No modifications were necessary in the twisting process although the operating tensions were reduced to compensate for the lighter reel weights of aluminum. Since this operation is the most severe and is the first process inspection point, it was decided to use it as a check point for defects so we could maintain a comparison with the results obtained on copper. As you can see in Figure 7 the overall defect rate for aluminum is somewhat higher than copper, but the relatively large percentage of opens is of much concern and is under continuous investigation for possible improvement. These opens are due to wire breaks that occur inside of the insulation and are carried through the machine without being detected. Consequently, it is necessary to rewind the defective reels for repair after they have been inspected. The main causes of these opens are failures of welded joints and foreign inclusions inherent in the rod supply. All the breaks are analyzed on a regular basis so the cause may be determined and steps for improvement can be initiated. A typical analysis of the breaks is shown in Figure 8.

FIG. 8

PAIRED WIRE DEFECT ANALYSIS

Type of Break	Percent of Opens	
	22 Gage	20 Gage
Tensile Failure	5.4	2.1
Adjacent to Weld	25.3	15.7
Internal Weld	30.1	47.8
Cavity	16.5	13.2
Imbedded Particle	3.3	2.8
Inclusion	2.1	2.0
Corrosion	3.7	2.4
Damaged Wire	13.2	13.3
Unclassified	.4	.7
TOTAL	100.0	100.0

Stranding and Cabling

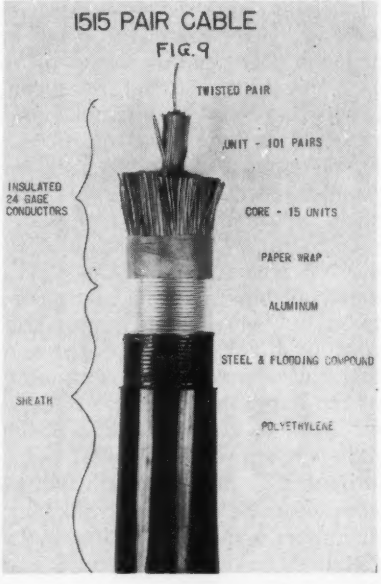
The stranding and cabling of aluminum wire into cable units and cores is done on the same machinery used to process copper. However, the supply and take-up tensions are set to the values used for the equivalent smaller gage in copper, that is for 20 gage aluminum settings comparable to those for 22 gage copper are used. We have been stranding all 20 and 22 gage aluminum on our high speed 600 feet per minute flyer strander and the 17 gage aluminum has been run on our older type 300 feet per minute flyer strander. The larger diameter conductors are run on the slower equipment only to take advantage of the available machine capacity. We have noted that the defect rate of aluminum at this operation is somewhat higher than for copper, but the increase is not of sufficient magnitude to justify any further development.

Drying

The procedure used for drying cable cores having aluminum conductors is the same as for copper; that is, the core trucks are placed under a heating dome and a D.C. current is passed through the conductors. At the same time a vacuum is applied and steam is passed through coils on the inside of the dome to accelerate the drying cycle. To maintain the same heating as in the copper conductors, the current density is maintained at 4,000 amps. per square inch by increasing the potential to one (1) volt per 23 feet of cable. With this change in operating procedure we have experienced no difficulty in drying and do not contemplate any changes in this equipment.

Sheathing

Aluminum conductor cable cores up to a maximum diameter of 2-3/8" (1515 pairs) are covered with a stalpeth sheath. This sheath is also used on copper conductors and consists of a corrugated .008" aluminum strip longitudinally wrapped around the core, followed by a corrugated .005" terne coated steel strip that is longitudinally wrapped and soldered. This assembly then receives an extruded covering of polyethylene, shown in Figure 9. We have experienced no difficulty in either the forming or polyethylene extrusion operations when sheathing aluminum conductor cable. However, the low specific gravity of the sheathed cable caused it to float in the cooling water trough and it was necessary to install submerging rolls to obtain uniform cooling and eliminate sheath damage.



Material Handling

Due to the 60% volume increase in cables containing aluminum conductors, the substitution of any sizable quantities of aluminum for copper will increase our material handling activity and require additional handling facilities, such as wire supply spools, pallets, insulated wire reels, and core trucks.

Rod Supply

At the time this development was started we were apprehensive of the effects of our processing machinery on these lower tensile strength conductors. It soon became apparent that the wire breakage was not due to the machine tensions, but instead was mainly caused by voids or cavities in the conductor that has reduced the wire cross-section to a hollow cylinder of greatly reduced strength. In the initial period of manufacture, we used annealed electrical conductivity type rod which is the rod used for electrical applications in the power field. However, the much larger conductor diameter used in the power field masked the effect of minute impurities and oxide inclusions that were inherent in the rod supply. To alleviate this problem we started a joint investigation with the aluminum companies who were very cooperative in supplying different types of trial rod. The first trial shipment consisted of material made from scalped ingots. It was expected that this shaving operation would reduce dross and other inclusions in the rod by reason of the clean ingot surfaces before the rolling operation. We did not notice any particular improvement due to this effort so grade "B" rod was tried. This material was cast from a cleaner melt into a large billet, scalped, and then bloomed to the desired size for rod rolling. This material showed a marked improvement but defects at the twisters continued at an impractical level and the rod imperfections remained as the largest single cause for open circuits. All of the rod used to that date was annealed dead soft before shipment and consequently was abraded very easily in transit and during subsequent handling. It was felt that due to this softness, surface imperfections would result or foreign materials could be picked up through surface contact thus introducing potential defects. The possibility of using a harder temper rod to eliminate this potential trouble was explored, but there was apprehension about drawing this harder material without intermediate annealing. All data available at this time indicated that aluminum drawn from hard rod to a finished size of 22 gage wire would probably harden beyond the point where its ductility could be restored. To determine the merits of this harder temper rod, material was purchased in H-12 temper which is the hardness as it comes off the rolling mill. Our first trial proved that the concern about excessive hardening during the drawing operation was unfounded and we were able to process this material without intermediate anneal and with greatly improved results. This reflected a marked reduction in defects due to inclusions at our twisting operation and at the same time reduced the rod cost since one annealing operation was omitted. We are continuing our studies of various supply rods in an effort to obtain further reductions in the associated defects.

Aluminum Conductor Joining

Two methods are used in the cable shop for joining copper. In the wire mill the supply rod at the No. 1 machine and supply wire at the No. 2 machine are butt welded. On the subsequent operations the conductors are brazed. With the introduction of aluminum we were faced with an entirely new problem, because of its relatively low melting point and the fact that it has metallurgical characteristics that make brazing or soldering impracticable. For either brazing or soldering aluminum, the flux is highly corrosive and requires a cleaning procedure not practicable for use on cable. In addition, the melting point is so close to that of the brazing alloys that the temperature control conditions are impracticable. A third condition that is a deterrent to this kind of joining is that the aluminum is so related to other commercial metals that galvanic action takes place between them if a joining alloy is used and corrosion is apt to take place. It, therefore, appeared that the only possible joint in aluminum is a true weld. Having had satisfactory experience in our Wire Mill welding copper with conventional butt welders and the fact that an identical method was being used in manufacturing aluminum power cables, a smaller model of the same type welder was chosen for joining 17, 20, and 22 gage aluminum. While we experienced good results when butt welding the larger diameters of aluminum in the Wire Mill, we soon found that the reduced diameters were again the cause of considerable difficulty. While the performance of this line voltage butt welder was satisfactory on 17 gage its performance on 20 and 22 gage was entirely too erratic to be tolerable. With these discouraging results our efforts were re-directed toward another type welder known as the stored energy or condenser discharge type. With this type welder the condenser is floating at a pre-set charged voltage obtained from a rectifying network to give a uniform heavy current discharge through the clamped wires at the time of welding. We noted considerable improvement in the welding of smaller diameter conductors using a condenser welder so we continued our analysis of the welding problems based on the use of this equipment. After determining what we felt were the optimum welding conditions there remained a variation in weld life that we felt was unsatisfactory based on past performances with copper. Further study showed that this was due to working of the metal during the processing operations where the conductors were twisted and received several reversed bends while passing over the various guide rollers and driving pulleys in the machines. This working in general concentrated itself adjacent to the weld and resulted in a conductor failure at this point. Examination of the weld joint showed that there was an up-setting of metal causing a mechanical notch and also the heat used during the process caused localized annealing resulting in a metallurgical notch. These two non-uniformities in the metal

(*Please turn to page* 240)

Story of a gal who couldn't cook

(or why use ELGIN Diamond)

When Susie walked down the street strange things happened. Men winked, wives frowned, cops whistled and cabbies tooted. Susie was a dish—charm in carload lots—sweet but shrewd, lovable but aloof.

As nature would have it, all the boys loved Susie and Susie loved the boys . . . especially when boys meant diamonds. This went on at a mad, happy pace until one sunny day Susie met Herbert. Right then and there, Susie knew that Herbert was for her. But, alas and alack, Herbert just couldn't see Susie. He couldn't—that is—until Susie had him over for dinner one night. Now, kitchen duty just wasn't Susie's strong suit. But, wily as she was, Susie changed her ways . . . made the cutest little ready-mix, no-mistake cake you ever did see. That did it . . . the crack in Herbert's armor was food. Herbert loved food. Herbert went simply c-r-a-z-y over food. Ah, glorious Waterloo . . . Herbert was hooked.

A foul deed you say? No! In this day and age, lots of things are ready-mixed and if a girl—*or anyone*—can use them to advantage . . . why not? Fact of the matter is, you're just as likely to find a ready-mixed product on the workbenches of industry as you are on the pantry shelf at home.

And that about tells the story of Elgin Diamond. For you see—Elgin Diamond is a ready-mixed abrasive which means there's no mixing or grading, no waste or error. And with Elgin's exclusive way of permanently suspending diamond particles in a specially formulated, color-identified vehicle—you get consistent polishing quality, too.

If you haven't already discovered what a wonderful product Elgin Diamond is, you certainly owe it to yourself to try it.

ELGIN NATIONAL WATCH COMPANY

ABRASIVES DIVISION ELGIN, ILLINOIS, Dept. G

Colloidal Graphite As A Wiredrawing Lubricant

by D. G. Weaver, Technical Editor
Acheson Colloids Company
Division of Acheson Industries, Inc.
Port Huron, Michigan

Except for the drawing of tungsten wire, there has been little said about colloidal graphite for other metals. The author discusses a broad range of this product's wiredrawing uses in this article.

The demand for more and better wire products in our modern economy has resulted in continually increasing production of all existing types of wire. Moreover, tough new alloys present unfamiliar production difficulties to the wiremaker, but improved dies and lubricants help to overcome these problems as they arise.

★ ★ ★

Varying physical properties of the many types of wire metal demand a wide range of operating procedures to obtain maximum practical ductility for the drawing operation along with specified characteristics in the finished wire. Thus, some wire is drawn cold, some hot; some wire is reduced only slightly by a pass through the die and must be heat-treated between draws; some can be brought down to final dimensions in a single die directly from rod or coil form; some wire is drawn with no die lubricant, some with liquid lubricant, some with quasi-liquid lubricant, and some with dry lubricant.

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Broadly speaking, there are two basic methods of drawing wire: the dry process and the wet process. In a typical dry-drawing operation, the rod or wire is acid-cleaned, coated with slaked lime, baked and drawn dry through a grease or soap compound in the lubricant box and into the die. A variation of this procedure utilizes soluble oils in the box for an otherwise dry operation. In one wet-drawing method, stock is plated by immersion in copper sulfate solution, then placed in a vat of fermented meal/yeast liquor from which it is drawn directly, the liquid serving to lubricate the die.

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Soft, ductile wire, like some copper or aluminum stock, is occasionally drawn cold with no lubricant at all. This is made possible by the use of proper die materials, well designed dies and favorable drawing speeds.

★ ★ ★

Exceptionally tough wire, such as stainless steel, is sometimes coated with copper, sometimes with tin or lead, to provide surface ductility in wet-drawing operations. Aluminum wire and fine sizes of ferrous wire are usually drawn with the help of compounded oils. Soluble oils or paste compositions of soap/fat mixtures are often used for larger gauges of ferrous wire and for copper and brass wire in high-speed, continuous drawing. Grease alone, put inside the lubricant box of dry-drawing machines, gives especially bright, clean finishes, where these are required.

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Extremely fine sizes of tungsten and molybdenum wire can be drawn successfully in production only when coated with a water dispersion of colloidal graphite and heated to leave a dry lubricating film on the wire surface. About 40 years ago the first tungsten filaments for electric lamps were drawn successfully with the use of 'Aquadag' ('dag' Colloidal Graphite in water). Today this same process is still being used for the very finest grades and sizes of filament wire. As shown in Fig. 1, the wire runs first through a "fountain" of diluted 'Aquadag'. This coats the surface with water-dispersed colloidal graphite. Heating dries the coating and raises the temperature of the wire to obtain optimum ductility. Colloidal graphite is one of the few substances that will adhere to wire at red heat. The "graphoid" film, formed by the graphited wire being drawn through the diamond die, permits continuous low-load drawing and greatly lengthens die life. Many other lubricants have been tested over the years, but nothing else has yet been found practical for this critical application.

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Drawing of steel wire is the most important today in terms of volume, variety and value of goods produced. In this field, both high-carbon and low-carbon steels are

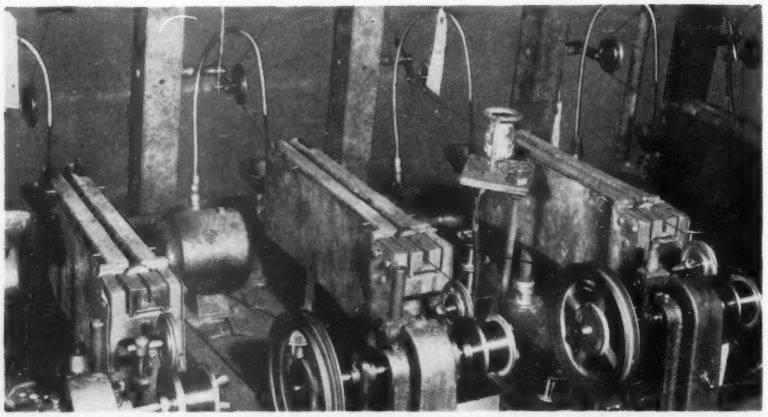

Fig. 1 Close-up of wire drawing machines at Thermionic Products, Plainfield N. J. * * *

pretreated with 'Prodag' (semi-colloidal graphite in water) by immersing the rods or coil stock in a diluted mixture of 'Prodag' and water, to which a wetting agent is usually added, and then baked in a 200°F. oven to dry the graphite film. The stock is drawn dry, and the single pre-coat often lasts through several consecutive reductions. In a typical case, production of as much as 200,000 pass-pounds through 90 gallons of diluted mixture has been regularly accomplished, with no graphite visible on the finished wire.

★ ★ ★

A considerable amount of work has been done recently on the effects of a wide range of lubricants in the hot-drawing of steel wire.* In this operation, lubrication is the essential problem. Tests on both dead-loaded and live machines have pointed up the great value of colloidal and semi-colloidal graphite for this process.

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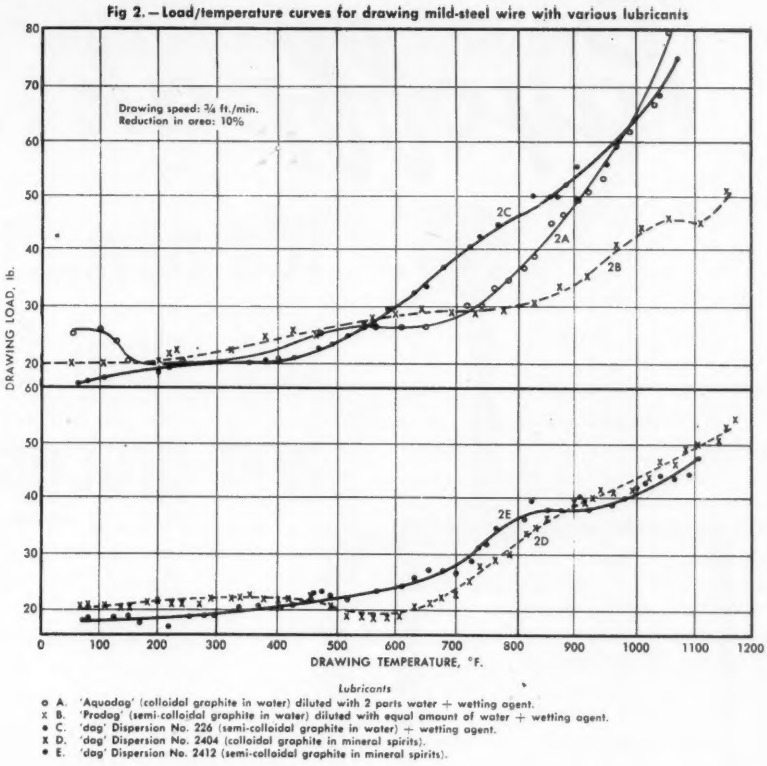
Several graphited drawing-lubricants were evaluated including the following standard dispersions: 'Aquadag', 'Prodag', 'dag' Dispersion No. 226 (another semi-colloidal graphite in water), and 'dag' Dispersion No. 2404 (colloidal graphite in mineral spirits). Stock being drawn was bright-annealed, mild-steel wire of 0.0475-inch original diameter, pointed first and then degreased by hand with benzene on a pad of cotton. New (only having been "run-in") tungsten carbide dies with a slight radial taper (semiangle, 5°) were used. Draws produced an area-reduction in the wire of 10%, at a speed of 3.4 feet per minute, at temperatures ranging from ambient to more than 1150°F. Drawing speeds were deliberately low, since a successful lubricant may be expected to behave even better at higher speeds.

*"The Drawing of Steel Wire at Elevated and Sub-Normal Temperatures", by Thompson, Carroll, and Bevitt. (Paper MW/D/52/51 of the Drawing Committee of the Mechanical Working Division of the British Iron and Steel Research Association.)

Fig. 2.—Load/temperature curves for drawing mild-steel wire with various lubricants


Drawing speed: ¾ ft./min.
Reduction in area: 10%
2C
2A
2B
2E
2D
DRAWING LOAD, lb.
DRAWING TEMPERATURE, °F.
Lubricants
A. 'Aquadag' (colloidal graphite in water) diluted with 2 parts water + wetting agent.
B. 'Prodag' (semi-colloidal graphite in water) diluted with equal amount of water + wetting agent.
C. 'dag' Dispersion No. 226 (semi-colloidal graphite in water) + wetting agent.
D. 'dag' Dispersion No. 2404 (colloidal graphite in mineral spirits).
E. 'dag' Dispersion No. 2412 (semi-colloidal graphite in mineral spirits).

★ ★ ★

'Aquadag', diluted 2:1 in water plus wetting agent, gave a smooth draw at temperatures higher than 900°F., although the drawing load began to increase considerably at temperatures above 700°F. 'Prodag', thinned 1:1 with water (with 2% by volume of wetting agent added), permitted entirely smooth drawing as high as 1100°F. 'dag' Dispersion No. 226 plus wetting agent provided consistently satisfactory results. Colloidal graphite in volatile carriers has shown exceptional promise. Dispersions in benzene and in alcohol performed very well. Graphite in mineral spirits was outstanding, the semi-colloidal form, represented by 'dag' Dispersion No. 2412, showing up best of all (Fig. 2).

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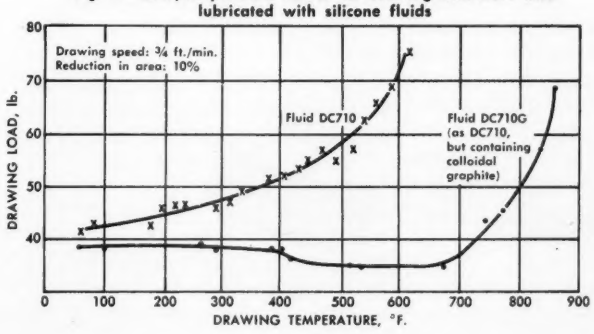
Under conditions of hot-drawing, temperature stability of the lubricants involved is a major factor in their successful performance.

(*Please turn to page* 229)

Fig. 3—Load/temperature curves for drawing mild-steel wire lubricated with silicone fluids


Drawing speed: ¾ ft./min.
Reduction in area: 10%
Fluid DC710
Fluid DC710G (as DC710, but containing colloidal graphite)
DRAWING LOAD, lb.
DRAWING TEMPERATURE, °F.

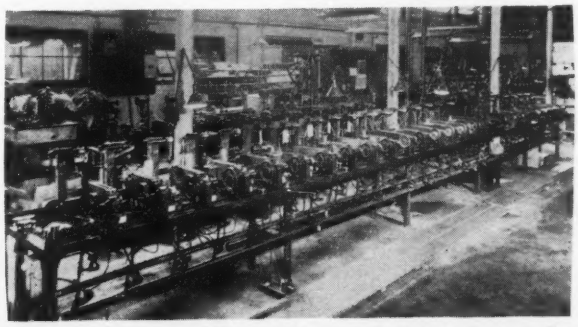


Fig. 4. Battery of wire-drawing machines at Thermionic Products, Inc., Plainfield, N. J. * * * * * * * * * * *

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The Natural and Artificial Aging of Wire Jackets

by

Charles W. Hamilton, Chemist
Rubber and Plastics Division
Battelle Memorial Institute
Columbus, Ohio

G. M. L. Sommerman, Res. Eng.
Westinghouse Research Laboratories
East Pittsburgh, Pa.

Robert I. Leininger, Asst. Chief
Rubber and Plastics Division
Battelle Memorial Institute
Columbus, Ohio

This paper was prepared jointly by the authors for the Third Annual Wire and Cable Symposium sponsored by the Signal Corps Engineering Laboratories at Asbury Park, N. J., on December 7, 1954. Mr. Leininger presented the paper. A portion of this paper was given at a meeting of the American Chemical Society in New York on September 17, 1954.

This study was conducted at **Battelle Memorial Institute** under the sponsorship of the United States Army Signal Corps, **Coles Signal Laboratory.**

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The purpose of this project was to correlate the natural outdoor-aging processes of plastic materials, particularly nylon, with those occurring under accelerated conditions in the laboratory. The plastic materials that were studied are those being used as the outer jacket on various types of cable used in army field service. It was desired to establish an accelerated-aging procedure that would, in a short span of time, produce the same effect as prolonged outdoor exposure, thus providing a convenient means of screening new modifications of these plastics as well as controlling their quality during production.

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The natural-weathering phase of this project was accomplished by exposing specimens of the materials under study at five different geographical locations.

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Fort Churchill, Manitoba, Canada. The specimens exposed at this station were handled by the Signal Corps Test Team of the United States Army. This location may be classified as arctic, rural, and is situated at about 58° north latitude.

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Columbus, Ohio. The samples were installed on the roof of a two-story building just outside the city limits. This site may be classified as temperate, urban, and is located at 40° north latitude.

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Yuma, Arizona. This exposure station was located in the desert outside Yuma and was administered by the 9575 Technical Service Unit of the Signal Corps. The latitude of this station is about 35° north, and the atmosphere may be considered desert, rural.

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Daytona Beach, Florida. The samples were mounted at the facilities of the North Florida Research Station of Battelle. The inland station is located at about 30° north latitude and is about 5 miles from the ocean front, far enough to eliminate any contact with a saline atmosphere. This station is considered semitropical, rural.

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Coco Solo, Canal Zone. The samples were exposed at the testing station maintained at Fort Sherman by the Naval Research Laboratory. This location, about 10° north latitude, is tropical, rural. An additional rack of specimens was stored on the floor of a hut located in the jungle, to observe the effects, if any, of microorganisms on the specimens.

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These several locations represented many different types of climates, ranging from arctic to tropical. The changes in physical properties of the specimens during the exposure period were studied. It was possible, in the case of the nylons to list them in order of their resistance to deterioration during outdoor aging. With most of the other materials, aging was too slow to become apparent in the allotted time. A comprehensive record of weather factors as they existed at the weathering sites was maintained in an attempt to determine the elements of climate that contributed most to the deterioration.

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In the case of nylon, specimens were supplied by du Pont in three forms: As extruded 30-mil monofilament, as 5-mil sheet, and as finished WD-1 infantry field wire. The wire was prepared according to Signal Corps specifications, and consisted of four coated copper strands and three coated steel strands covered with polyethylene insulation over which is extruded a sheath of nylon. The insulation had a minimum thickness of 14 mils, while the jacket had a minimum thickness of 6 mils.

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The specimens were manufactured from four types of nylon designated, respectively, FM-3606, FM-7001, FE-2103, and FE-1085. The first type, FM-3606, is the type now approved for use by the Signal Corps and possesses the maximum resistance to weathering now available. Of the other three types, FM-7001 is reputed to be the least permanent, while FE-2103 and FE-1085 have an intermediate rating. For the sake of uniformity,

all of the specimens of each type of nylon, were prepared from the same batch of that type.

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The racks used to hold the samples during exposure were of two general types, designated "loom-type" and "plate-type". The loom-type rack was constructed specifically to hold filament and WD-1 wire samples, while the plate-type racks were designed to accommodate the sheet samples. An illustration of each of these types of racks is shown in Figures 1 and 2. In addition, a rack of filament samples fitted with a special sunshade was supplied to each station to permit a study of the effect of sunlight. The effect of biological attack was noted by providing the tropical exposure station with an extra rack of filament specimens which was stored on the ground in an enclosed hut in the jungle. The exposed racks were mounted facing south, at an angle with the horizontal equal to the latitude of the location, to provide for maximum average exposure to the sun.

The other types of plastic materials exposed included GR-S synthetic rubber, perbunan-vinyl and low-temperature vinyl.

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GR-S. Two companies furnished samples of GR-S synthetic rubber compounded for use on 5-pair cable. This cable contains 5 pairs of conductors, each separately insulated with polyethylene; the assembly was totally enclosed in a polyethylene sheath covered with the GR-S jacket. One company also furnished 30 pounds of the GR-S compound for molding samples.

★ ★ ★

Perbunan-Vinyl. This material is a mixture of perbunan synthetic rubber and polyvinyl chloride. It is used to jacket Spiral-4 cable, which consists of four stranded copper conductors, each insulated with polyethylene, cabled around a central polyethylene core. An inner jacket of polyethylene, a carbon-cloth stabilizing tape, a stainless steel braid, and the perbunan-vinyl jacket complete the cable. The manufacturer furnished 100 feet of the cable and 30 pounds of the jacket compound.

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Low-Temperature Vinyl. This material is a plasticized vinyl compound. It is used in the same manner as the perbunan-vinyl compound on Spiral-4 cable. The jacketing was also supplied as tubing (0.365 in. O.D. and 0.066-in. wall).

Mounting of Samples

The miscellaneous plastic samples were mounted on 14 x 30 x 0.065-inch aluminum panels perforated with 0.25-inch holes spaced 0.75-inch apart center to center. The specimens were fastened with 1/4-inch bolts. This system gave complete freedom of arrangement of the specimens on the panel. Several samples of either nylon or miscellaneous plastic materials were placed on each panel, but each panel was considered one unit, and was removed after exposure as such. A typical panel is shown in Figure 3.

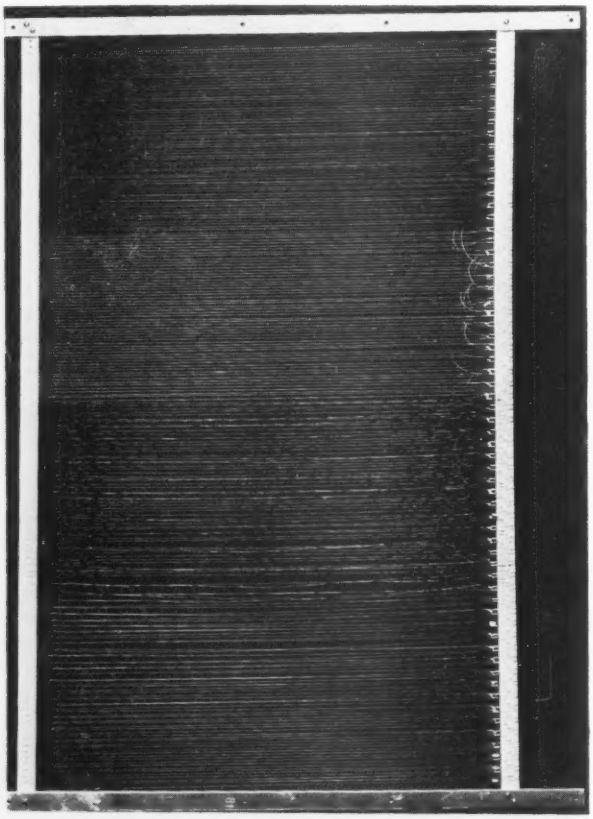

Fig. 1. Typical rack, illustrating the method of mounting the Nylon filament specimens.

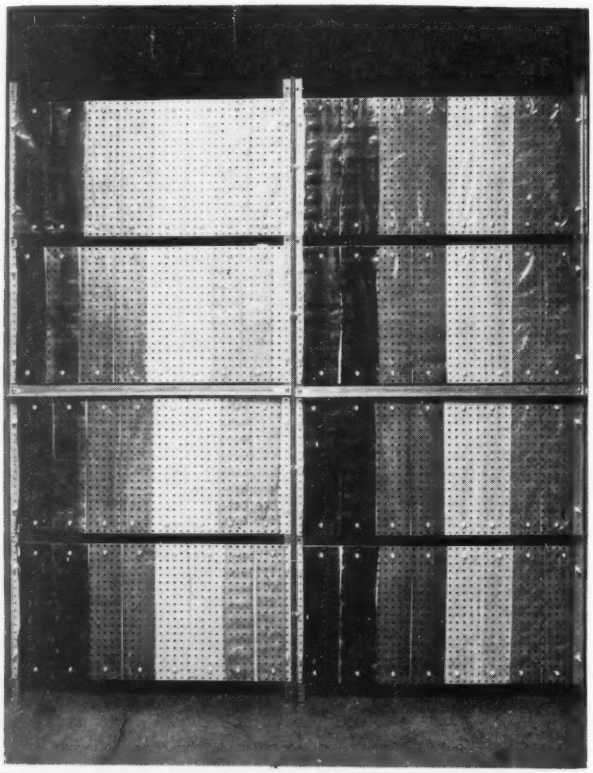

Fig. 2. Typical rack, illustrating the method of mounting the Nylon sheet specimens.

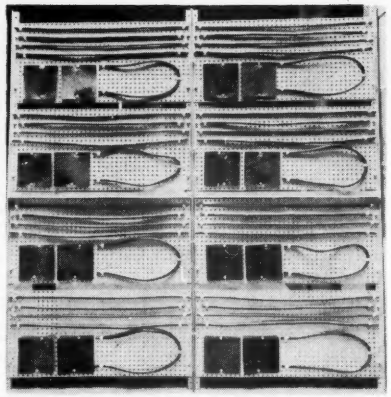

Fig. 3. Typical rack, illustrating the method of mounting the miscellaneous plastic specimens.

Each panel contained a 30-inch length of each of the following cables arranged from the top down in this order: Spiral-4 cable jacketed with Bakelite QG-5924 Black 99; 5-pair cable jacketed with GR-S (Okonite); Spiral-4 cable jacketed with perbunan-vinyl; 5-pair cable jacketed with GR-S (U. S. Rubber). The other samples were slabs molded from the jacketing compounds, and an extruded tube of low-temperature vinyl.

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Sufficient samples were supplied to each station to permit continuation of the exposure program for 5 years; this report covers only 18 months. The Signal Corps is following the results of continued exposure. Since most of the rapid deterioration was expected to occur during the early portion of the exposure period, it was arranged for samples to be returned monthly for the first 6 months. The next two samples were returned after 9- and 12-month exposures, respectively. After that, samples were removed at 6-month intervals.

Climatic Factors

The factors responsible for the deterioration of organic materials may be classified as heat, light, oxygen, moisture, and microorganisms. A climate is primarily defined by the summation of three of these factors: heat, light, and moisture. The elements of weather having influence on these factors include hours of sunshine, intensity of sunlight, temperature, precipitation, wind velocity, and relative humidity. The compilation of weather data in terms of factors related to the degradation of organic materials thus presents a very difficult problem. In many cases, the same types of data were not available from every station, or the data were not recorded in the same manner nor under similar conditions. This made accurate comparison of conditions difficult. However, as will be seen, certain worthwhile comparisons can be made between climate factors and rate of deterioration.

Physical Testing Procedures

Appropriate tests were designed to evaluate the changes occurring in the samples during exposure. In order to obtain relative values of the service life of the WD-1 wire under various climatic conditions and with different types of nylon jackets, each sample was subjected after exposure to a mandrel-wrap test at -40°C. Signal Corps specifications require that the jacket of this wire, after conditioning at this temperature for 24 hours, not crack when five close turns of the wire are made on a mandrel of the same diameter as the wire. Since the unaged wire passed this test, it was assumed that serious deterioration had begun if, after aging, the sample no longer passed the test. Therefore, for the purposes of this project, the service life of the wire was defined as the number of months of exposure necessary to degrade the wire sufficiently to cause failure of the jacket during the mandrel-wrap test at -40°C. The application of this test revealed that the four types of nylon employed deteriorated in the same relative order, irrespective of the location at which the samples were exposed. The estimated service life of each type of nylon is given in Table 1. It is readily seen that FM-3606 has been established as the type most resistant to aging, FM-7001 least resistant, and FE-2103 and FE-1085 of intermediate resistance. Nylon FE-1085 seems to be slightly better than FE-2103.

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In the case of the other plastics, the tensile strength and resistance to cracking in the mandrel-wrap test were determined. The specimens were in the form of molded slabs, tubing, and finished cable, as previously described. The tensile properties of the molded slabs of GR-S and perbunan-vinyl were determined on a Dillon universal testing machine by using a standard dumbbell specimen. (Die D, A.S.T.M. D412).

★ ★ ★

In order to determine the tensile properties of the vinyl-tubing specimens, it was necessary to slit the samples down the unexposed surface. The specimens were spread flat on a board and the dumbbell specimens cut from them. These samples then could be tested in the same manner as the slab samples.

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In addition to the above samples, sections of finished cable in the four jacket compositions previously described were also exposed. These were subjected to the standard mandrel-wrap test at -40°C., as prescribed in the Signal Corps specifications. Only Spiral-4 specimens jacketed with perbunan-vinyl failed this test during 18

TABLE 1. ESTIMATED SERVICE LIFE OF WD-1 WIRE AT VARIOUS LOCATIONS

Nylon Type	Service Life in Months at Each Location				
	Canal Zone	Florida	Arizona	Ohio	Canada
FE-2103	3	3	3	3	3
FM-3606	9	12	12	12	>18
FM-7001	2	1	1	1	3
FE-1085	4	9	6	5	9

months' exposure.

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The physical properties of these jacketing materials measurably degraded during this exposure. This change was not great enough to cause failure in the mandrel-wrap test, except for the perbunan-vinyl.

Field Degradation of Nylon

Since the degradation of nylon presumably involves an alteration of the molecular structure, it may be expected that these changes are reflected in the solution characteristics of the material. A very sensitive index of the structure of a polymer is the intrinsic viscosity of its solution in some suitable solvent. Viscosity measurements of nylon jackets that had been removed from the wire, and of nylon sheet samples, were made using m-cresol as the solvent. Ostwald-Fenske viscosimeters were used to make the determinations.

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During natural aging, the nylon wire jackets exhibited a slow decrease in molecular weight. However, the values obtained were erratic and the decrease was of low order, making it impractical to use the data. This was attributed to the fact that only one side of the wire jacket (the outside) was exposed and that only a portion of this was directed toward the sky. Changes occurring, therefore, would be masked by the presence of unexposed portions of the jacket.

★ ★ ★

The nylon sheet samples exhibited the effects of deterioration to a greater extent, the rate of deterioration depending on the exposure location. The curves of an example in Figure 4 are typical of a rapid decrease in viscosity. The change, however, is rapid for all four kinds of nylon and does not differentiate among them to give correlation with service-life tests.

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The rate of change of the tensile strength of nylon filaments during unshaded exposure gave the truest indication of the rate of deterioration of the nylon as compared to the service life of the

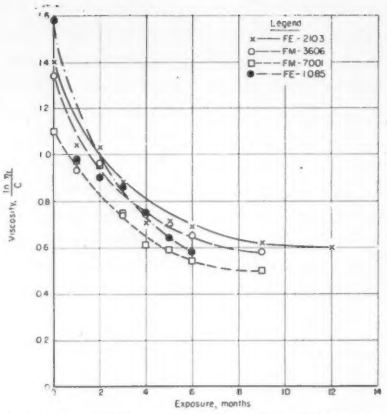

FIGURE 4 VISCOSITY OF NYLON SHEET EXPOSED AT COCO SOLO, CANAL ZONE

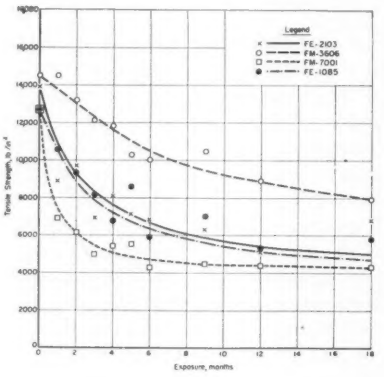

FIGURE 5 TENSILE STRENGTH OF NYLON FILAMENTS AFTER UNSHADED EXPOSURE AT COLUMBUS, OHIO

wire. For example, Figure 5 is a plot of the tensile strength of the four types of nylon in filament form versus months of exposure at Columbus, Ohio. It will be noted that FM-7001 rapidly drops to about half of its original tensile strength in 2 months, while FM-3606 is above this figure even after 18 months. Also, it will be noted that the other types of nylon maintain an intermediate rate of deterioration of tensile strength. Similar curves are obtained at other exposure stations. Table 2 shows the per cent loss of tensile strength at each station for each nylon when FM-7001 has lost about 50 per cent of its original strength. These figures show clearly the relative order of resistance to deterioration of the four nylon types. FM-3606 is most resistant, followed by FE-1085, FE-2103, and FM-7001. When the rate of change of tensile strength is compared according to the geographical location of the exposure, the following order of increasing severity is found: Canada, Florida, Panama, Arizona, and Ohio. The accumulated weather data are too bulky to be presented as a part of this paper. Suffice it to say that no natural weathering factor that was

TABLE 2. COMPARATIVE CHANGES IN TENSILE STRENGTH OF NYLON FILAMENTS AFTER UNSHADED EXPOSURE

Location	Nylon Type	Change in Tensile Strength After 6 Months' Exposure, per cent	Change in Tensile Strength After 12 Months' Exposure, per cent
Canada	FE-1085	+12.6	-18.1
	FE-2103	+3.6	-25.2
	FM-3606	-8.3	-23.4
	FM-7001	-30.4	-47.3
Florida	FE-1085	-11.0	-34.6
	FE-2103	-11.5	-41.0
	FM-3606	-15.8	-26.9
	FM-7001	-42.5	-57.5
Canal Zone	FE-1085	-22.0	-48.0
	FE-2103	-38.8	--
	FM-3606	-22.1	-55.1
	FM-7001	-50.5	--
Arizona	FE-1085	-35.4	-37.8
	FE-2103	-41.7	-49.6
	FM-3606	-28.2	-33.1
	FM-7001	-64.5	-69.3
Ohio	FE-1085	-53.5	-58.3
	FE-2103	-51.0	-63.3
	FM-3606	-31.0	-38.6
	FM-7001	-66.0	-65.3

measured could be found that would explain the severity of the degradation at the Ohio location. Therefore, it was concluded that other factors were operative at this station. Since it was the only urban location used, air pollution might be partially responsible.

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Considering only the rural locations, the factor that places the stations in the proper deteriorative order was maximum daily temperature, suggesting that heat is a primary degradative factor. This is also supported by the fact that unshaded specimens deteriorate faster than protected specimens. While this latter fact might indicate that ultraviolet light is important, it is also true that the exposed specimens become hotter than those that were shaded. Moisture, considered by some as a primary cause of nylon deterioration, was shown to be ineffective by performance of the specimens stored in the jungle hut. The relative humidity in this location was nearly 100 per cent constantly; yet the physical properties of these filaments were unchanged after 18 months.

Electrical Testing Procedures

Early in the program, it was decided to include measurements of the electrical properties of nylon as a means of evaluating chemical and physical changes in the nylon. Moreover, the dielectric constant and dissipation factor of the nylon jacket of WD-1 field wire enter as second-order factors in the overall characteristic impedance and propagation constant of the field wire. These factors are functions of temperature and frequency. To simplify the tests for evaluation of degradation, however, work was directed to finding one temperature and conditioning procedure for which the electrical properties of nylon would be sensitive to differences in degradation.

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The electrical tests were performed on sheet samples (3 to 5 mils thick) to which were applied silver-paint electrodes, including a guard electrode. The silver-paint electrodes gave the same results as sputtered metal electrodes; foil electrodes, however, did not give the same results. Copper electrodes were placed in contact with the silver-paint electrodes; these minimized the temperature changes which occurred in the heating chamber. Some of the tests during the summer of 1953 were conducted in a vacuum-tight test cell placed in an oven. Most of the tests were made by placing the samples and electrodes on insulators in a grounded metal oven containing trays of desiccant. The samples were dried at 95°C. for 16 hours and tested at 65°C. Dissipation factor and capacitance were measured at several frequencies by a Schering bridge with Wagner ground connected to the samples by shielded leads. Direct-current conductivities were measured by connecting the shielded leads from the samples to a galvanometer circuit.

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Before standardizing on the 65°C. test temperature, dissipation factor versus frequency data were obtained at several temperatures: 85°C., 65°C., 45°C., 25°C. At 85°C., the dissipation factors were very high (20 per cent, or more) at frequencies in the range 400 c.p.s. to 100,000 c.p.s.; d.-c. conductivities were also very high. At 45°C. and lower, the dissipation factors of new and aged nylons were nearly the same; also, at these temperatures, the samples picked up moisture during measurements in the oven. At 65°C., experimental difficulties appeared to be at a minimum; in addition, a significant difference existed in the electrical properties of new and aged nylon. For new nylon, the dissipation factor increased with frequency, while, for aged nylon, the dissipation factor decreased with frequency. An arbitrary factor, designated as the frequency-increment in dissipation factor at 65°C., was defined as follows:

$$\triangle DF_{65} = (DF \text{ at } 100 \text{ k. c. p. s.})_{65} - (DF \text{ at } 400 \text{ c. p. s.})_{65}$$

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This factor and the d.-c. conductivity at 65°C. were used as degradation criteria for the nylons in all subsequent work.

Test Results of Electrical Properties

Samples of the nylon sheets were received at intervals from each of the five field stations. Portions of these that were free from obvious physical defects were selected for the electrical tests. The results of these electrical tests on field-aged nylons were plotted, for a given material, to give curves of electrical-dissipation-factor increment and d.-c. conductivity versus months of outdoor exposure. As shown by the representative data in Figure 6, separate curves were drawn for the samples from the five field stations.

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The main trends in the average results for the electrical properties

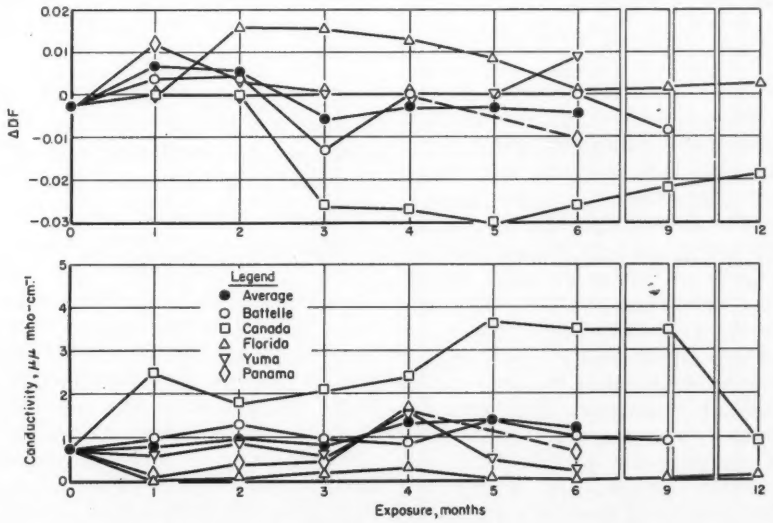

FIGURE 6. ELECTRICAL PROPERTIES OF FE-1085 NYLON SHEETS AFTER OUTDOOR AGING

are: (1) a decrease in the dissipation-factor increment for FM-3606, FM-7001, and FE-2103 nylons; (2) a large decrease in the conductivity for FM-7001 nylons; and (3) a small increase in conductivity for FM-2103 nylon. Except for the FM-7001 nylon, however, the changes in average electrical properties are smaller than the effects on the electrical properties of exposure at different field stations. Thus, it is informative to examine the changes in properties of the nylons in relation to the location of exposure to outdoor weathering.

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For all four nylons, samples exposed in Florida and Panama are low in conductivity and show little change in dissipation-factor increment, as compared with the original properties. Samples exposed in Canada have the highest conductivities and, in nearly all cases, the lowest dissipation-factor increments. For all nylons except FM-7001 (plasticized), the conductivities of samples exposed in Canada are substantially higher than the original values. Results for samples exposed in Ohio and, in most cases, for those exposed in Arizona, fall between the results for the other samples.

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The very high conductivities found for FM-7001 nylon exposed 1 and 2 months in Arizona may be due to degradation of the plasticizer in this nylon. A similar effect was found when this nylon was exposed to low-energy X-rays, as described in a later section of this report.

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The electrical data obtained on the samples exposed at Florida and Panama indicate that water-soluble impurities originally present in the nylons are leached out by the action of rainfall at these locations. Apparently, some of the plasticizer and water-soluble impurities in FM-7001 nylon are leached out at all field stations, the action being least in the samples exposed in Canada. For the other three nylons, there is less evidence of leaching out of impurities for samples exposed in Yuma and Ohio, and still less for samples exposed in Canada. In fact, there is evidence of a net increase in impurities or an increase in ionizable reaction products in the samples exposed in Ohio and Canada. Some of the impurities and/or reaction products accumulated in the samples exposed in Canada may have been leached out during the summer of 1953, as shown by the lower conductivity values after 12 months of exposure. The reaction products may result from hydrolysis of the nylons.

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The results of electrical tests on nylon sheets show that the changes that occur in nylon depend markedly on the weather conditions to which the sheets are exposed.

Accelerated Aging

Climatic Factors: Simultaneous with the exposure tests, artificial methods of degradation were used to promote deterioration comparable to that occurring outdoors. Tests were designed to measure the effect of moisture, heat, and ultraviolet light, individually and in various combinations, upon the physical properties of the several nylons.

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Specimens of nylon in the form of sheet, filament, and WD-1 wire were exposed in the dark for periods up to 84 days in an atmosphere maintained at 50°C. and 100 per cent relative humidity. No apparent change in physical properties occurred. Specimens of FM-3606 filament and FM-7001 filament were extracted to constant weight with water, with the result that the FM-3606 sample lost 1.5 per cent of its weight and the FM-7001 sample lost 12.5 per cent. However, there was no comparable change in physical properties.

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Similarly, samples of nylon were exposed to ultraviolet light from an Atlas enclosed carbon arc. There was no noticeable change in the tensile properties of the filament or in any property of the WD-1 wire. However, over a period of 8 days, small decreases were noted in the intrinsic viscosity of solutions made from exposed sheet samples. FM-7001 nylon exhibited considerably more change than the other three types, of the order of 23 per cent.

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The greatest effect noted was that due to oven aging in the dark at temperatures in excess of 120°C. Nylon sheet of all four types exhibited very small increases in molecular weight over a period of eight days. At 140°C., these increases were considerably greater, except for FM-7001, which showed a decrease, while at 150°C. and 160°C., the variations became erratic, with most of the specimens becoming insoluble in m-cresol after a few days exposure. The erratic behavior at the very high temperatures might be explained on the basis that at these temperatures it becomes very difficult to provide a very even heat throughout a large sample in an air-circulating oven. Since the experiments at 140°C. provided the greatest changes without inducing insolubility, it has been chosen for illustration at this point (Figure 7). It will be noted that, in general, an increase in molecular weight occurs initially (except for FM-7001), and is then followed by a decrease.

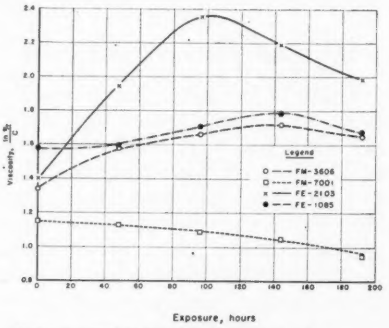

FIGURE 7 VISCOSITY OF NYLON SHEET AGED AT 140°C

The variations occurring in the tensile strength of nylon filaments during oven aging correlated very nicely with those occurring during natural aging. At 120°C., practically no change occurs over a period of 10 days. However, at 140°C., a very definite decrease in tensile strength occurs in all four types of nylon. Curves obtained during one of these trials are shown (Figure 8). It will be noted that excellent correlation exists between these curves, covering an 8-day cycle, with those obtained for exposure at a typical outdoor exposure station such as Yuma, Arizo-

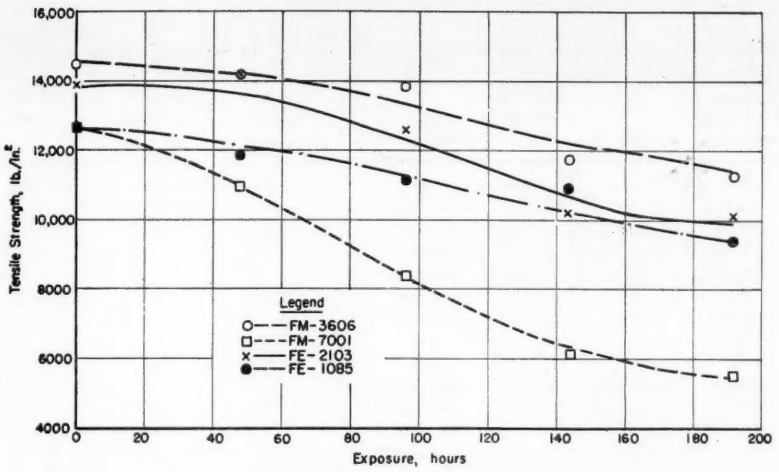

FIGURE 8. TENSILE STRENGTH OF NYLON FILAMENTS AGED AT 140° C.

A-10695

na (Figure 9). Again, exposure of the filaments to higher temperatures caused erratic results and very rapid deterioration.

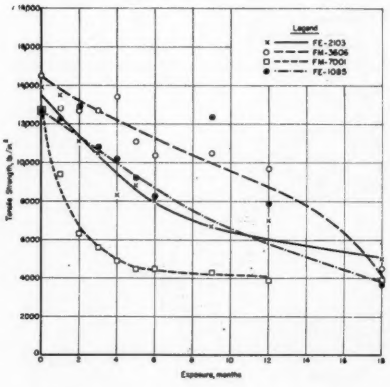

FIGURE 9. TENSILE STRENGTH OF NYLON FILAMENTS AFTER UNSHADED EXPOSURE AT YUMA, ARIZONA

The effect of exposing nylon samples to atmospheres in which more than one variable is accentuated was also studied. It was found that air saturated with water vapor had very little effect at moderate temperatures up to 50°C. However, if samples were irradiated with ultraviolet light under these same conditions, a slight decrease in molecular weight and tensile strength was noted. These changes became more pronounced as the temperature was increased to 80°C. Tests under these conditions, however, exhibited very poor reproducibility, probably because of uneven deterioration throughout the sample.

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Electrically Accelerated Aging Tests as part of the program of developing accelerated-aging procedures that would simulate the effects of prolonged exposure to natural weathering, two electrical procedures were investigated. One of these, undertaken at the suggestion of Dr. R. C. McMaster, was to expose samples of nylon to low-energy X-rays. This procedure was investigated on the basis of other work that had indicated that low-energy X-rays produced chemical changes in materials similar to those produced by ultraviolet light. The second electrical procedure consisted of exposing samples of nylon to gaseous ionization or glow discharge under controlled conditions of gas pressure and moisture content. The apparatus and techniques used were based on those developed for evaluating the resistance of insulating liquids to ion bombardment.

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In the X-irradiation tests, samples of both sheet and filament nylon were irradiated under controlled conditions. The X-ray source was a Machlett OEG-60 tube energized at 60 k.v.p. in most of the tests; a voltage of 25 k.v.p. was used in a few tests. The dosage was controlled by using a fixed plate current (28 ma. in most cases) and various exposure times. Dosages ranged from 45 to 360 megaroentgens (42 hours at 28 ma. and 60 k.v.p. were required to give a dosage of 360 megaroentgens). The samples were mounted at a fixed distance from the X-ray tube target; they were covered with a lead mask with a window 2 inches square cut in it. The X-irradiation was practically uniform over this area.

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The samples were irradiated at ambient temperature and humidity in most cases. One test was made on a well-dried sample.

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After the samples were irradiated, they were subjected to various tests. The sheet samples were checked for changes in light transmission; measurements of electrical properties and solution viscosity (for molecular-weight determinations) were then made. The filament samples were tested for tensile strength and elongation; brittle-point temperatures were determined in a few cases.

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Evaluation-test data obtained on the various samples of nylon, both sheet and filament, X-irradiated at 60 k.v.p. are presented in Table 3. The light transmission through nylon sheet was reduced after X-irradiation for all four types of nylon. For each type of nylon, the light transmission decreased with increase in exposure up to about 90 megaroentgens, after which there was no further significant change in light transmission with dosages up to 360 megaroentgens.

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The molecular weight of each of the nylons (based on solution viscosities) decreased rapidly on exposure to X-rays when dosages of 43 and 90 megaroentgens were used. For FM-7001, FE-1085, and FE-2103 nylons, there was little further change in molecular weight with increase in dosage in the range from 90 to 360 megaroentgens. For FM-3606 nylon, the molecular weight apparently increased again as increasing dosages above 90 megaroentgens were applied. This occurred to a limited extent for the FE nylons, also.

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The tensile strength and elonga-

TABLE 3. ELECTRICAL AND PHYSICAL PROPERTIES OF X-IRRADIATED NYLONS

		Sheet Samples					Filament Samples		
Sample No.	Nylon Type	Dosage, mega-roentgens	Conductivity at 65°C., Λ_{65}, $\mu\mu$mho-cm.$^{-1}$	ΔDF_{65}	Molecular Weight, $\overline{M}_n$	Light Transmission	Tensile Strength, lb./in.^{2}	Elongation at Break, per cent	Brittle Point, °C.
Avg-OX	FM-3606	Unaged	1.5	-0.012	16,900	High	14,500	362	<-70
22-X	"	43	(5.5)	(-0.002)	10,900	Med. high			
14-X	"	90	1.5	-0.040	9,500	Medium	13,200	278	
1-X	"	180	1.9	-0.100	11,600	Medium			
9-X	"	180	1.5	-0.025	11,700	Medium			
11-X	"	180	0.1	-0.052	16,500	Medium	7,700	202	-60
18-X	"	360	3.9	-0.054	Insoluble	Medium			
Avg-OX	FM-7001	Unaged	29	+0.01	13,400	High	12,700	393	<-70
23-X	"	43	Shorted	Shorted	10,900	Med. high[a]			
15-X	"	90	78	-0.32	5,300	Medium[a]	7,900	300	
3-X	"	180	350	-0.37		Medium[a]	6,000	148	-54
19-X	"	360	41	-0.21	4,000	Medium[a]			
Avg-OX	FE-1085	Unaged	0.7	-0.002	21,300	High	12,700	358	<-70
24-X	"	43	(1.8)	-0.004		High			
16-X	"	90	0.9	0.000	12,300	Medium	10,400	288	
12-X	"	180	<0.1	0.000	13,400	Medium	9,200	280	-68
20-X	"	360	0.2	-0.001	13,200	Medium			
Avg-OX	FE-2103	Unaged	<0.1	+0.007	17,900	Medium	13,900	379	<-70
25-X	"	43	<0.1	+0.006		Medium			
17-X	"	90	<0.1	+0.006	11,700	Low	10,200	264	
13-X	"	180	<0.01	0.000	13,000	Low	9,100	300	-70
21-X	"	360	<0.1	+0.004	14,000	Low			

(a) Yellow.

tion of all four types of nylon decreased with increasing X-ray dosage, at least up to dosages of 180 megaroentgens. The brittle-point temperature for all nylons is increased moderately upon exposure to an X-irradiation of 180 megaroentgens.

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The effects of X-irradiation on the electrical and physical properties of all four types of nylon studied were very similar to those observed after the nylons had been exposed from 1 to 3 months in Arizona. On a comparative basis, the effects of X-irradiation were greatest for FM-7001 nylon and least for FE-2103 nylon.

A sample of nylon, X-irradiated in a dry condition, was found to be less dark, greater in d.-c. conductivity, and lower in molecular weight than similar samples X-irradiated at ambient humidity. This suggests that the presence of moisture affects the aging of nylon with X-irradiation.

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Results of X-irradiation tests at 25 k.v.p. show that there is no substantial difference in the results for the two voltage conditions. It is possible that the use of X-irradiation of still lower energy would give different results. This, however, would require such long exposure times as to make the test unfeasible, economically.

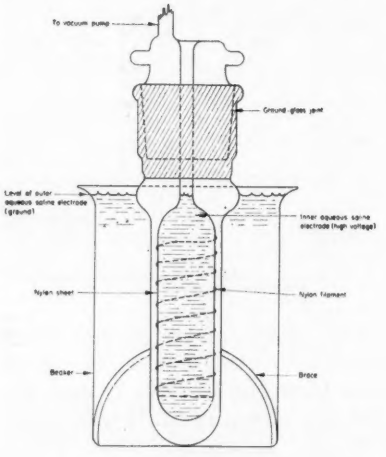

FIGURE 10 ION-BOMBARDMENT CELL

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In any further work on developing an accelerated laboratory aging test to simulate the effects of weathering on nylon, the use of X-irradiation in combination with a heat and moisture-condensation test should be tried.

★ ★ ★

To carry out the ion-bombard-

(*Please turn to page* 233)

TABLE 4. EFFECTS OF ION BOMBARDMENT ON ELECTRICAL AND PHYSICAL PROPERTIES OF NYLONS[a]

Nylon Type	Exposure Time, hours	Total Gas Evolution, mm. Hg	Change in Weight, per cent	Conductivity at 65°C., Λ_{65}, $\mu\mu$mho-cm.$^{-1}$	ΔDF_{65}	Molecular Weight, $\overline{M}_n$	Tensile Strength, lb./in.^{2}
FM-3606	0	--	--	1.5	-0.012	16,900	14,500
"	4	280	-1.8	3	-0.013	13,300	14,500
FM-7001	0	--	--	30	+0.010	13,400	12,700
"	4	250	-1.2	8	0.000	8,000	13,400
FE-1085	0	--	--	0.7	-0.002	21,300	12,700
"	4	270	-1.5	0.3	+0.007	6,000	15,100
FE-2103	0	--	--	0.1	+0.007	17,900	13,900
"	4	280	-0.9	0.1	-0.005	4,500	19,000

(a) Ion bombardment conditions: 200 kilocycles, 140 watts input.

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SINCE 1843 — BRIDGEPORT 3, CONNECTICUT, U. S. A. — INCORPORATED 1881

Wire Drawing Lubricants

by

Ing. Fritz Rabenhorst

Germany

The purposes of lubricant are:

1. **Reduction of frictional resistance,**
2. **Avoidance of stop-and-go of the wire and consequent wire losses,**
3. **Increase of tool life,**
4. **Greater velocity of drawing,**
5. **Cooling,**
6. **Protection against corrosion.**

★ ★ ★

For the better application of the proper drawing compound use is made of the so-called lubricant carrier. This can be (a) chemical formation of a surface film, as represented by phosphating or bonder processes, (b) coating of lime, borax or graphite, or (c) patenting—lead coating in the drawing of steel wire or copper plating—wet drawing. Among the appropriate lubricants can be distinguished the dry, the paste and the liquid; choice among them is determined by the conditions of the operation.

Dry Lubricant

The lubricant is composed of pulverized sodium soaps. It is used where slight or no regard is had for the appearance of the surface of the wire. That is, for heavy reductions of larger wire diameters at slow speeds or in high-speed multiple drawing,—this latter because dry soap will stand higher temperatures. (Decomposition at about 284°F). The soap should not, however, contain less than 60% fatty acid nor less than 40% water. The most commonly applied sodium soap is used in needle-flake or in powder. Lime-coat is mostly used as carrier, though the other carriers are sometimes chosen.

Paste Lubricant

Fatty matter and mineral oils soluble in water are not available for use. We find them both in heavy and medium drawing mostly with lime carrier. Although many of these lubricants are obtainable in the market, in numbers of industries even today they are self-prepared. As a basis for firmer fat, beef tallow; and for a more fluid, rape oil are exclusively used. For this there are two recipes:

This article is a portion of a paper that appeared in the August 10, 1955, issue of Draht-Welt. That portion of the paper relating to lubricants was translated by Jerome W. Howe, Worcester, Mass., and is used with the permission of Draht-Welt.

(1) To three parts by weight of beef tallow add one part by weight of rape oil and cook together about two hours.

(2) To three parts by weight of melted beef tallow add four parts by weight of common lubricating oil and one and a half parts by weight of pulverized caustic potash, and with continual agitation, cook for about three hours.

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The wire maintains the typically oily up to an oil-free surface. It is of advantage that the lubricant, after pickling—in contrast to dry-drawing—is easily removed for wet-bright further drawing. Therefore wire produced in this manner will be favored for the further working by bright-drawing.

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Lubricated wire should be drawn as continuously as possible clear through to the final diameter. Cold lubricant is less adhesive, whereby the die life can be considerably reduced. Since certain synthetic fatty acids used with a lime carrier form a hard insoluble lime soap which stops the drawing, the drawing must be continuously watched. Rape oil mixtures are less susceptible to such possibilities, though more costly.

Wet Lubricants

In this category are pure mineral oil and the water-soluble drawing compounds.

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They have the property of adhering less firmly to the metal surface and are therefore used for finer wire, because the drawing speed can be higher and the danger of rupture less. One advantage is the better and direct cooling. The appearance of the surface is smooth and clean. Copper sulphate is principally used as lubricant carrier.

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While in dry and lubricating-grease drawing the application of the lubricant must be made from special lubricant holders placed before the dies, with wet lubricants the wire is drawn from the coil out of the liquid, or in splash drawing with a constant circulation of the liquid. The concentration of lubricant is regulated by the velocity of drawing. Although for this also a great choice of lubricants is on the market, the following recipe is given:

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One part by kilogram weight of lubricant soap, dissolved in water, with an equal part by weight of rye meal, thinned with water, whipped and mixed with 20% of the same part, measured in liters, of rape oil. For example: 1 kilogram of soap, 1 kilo. of meal, 0.2 liters of rape oil. Cook with continual agitation with not too hot a fire until the whole has hardened. The resulting paste is now brought to the take-off, thinned to the desired concentration in four to six buckets that contain 40 to 60 liters of water.

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In connection with the above, again allusion is made to the difficulty of wet-bright drawing from wire drawn with soap. As the soap is removed with difficulty, the pickle bath must have a higher concentration than, for example, with oil-lubricated wire. Before pickling, moreover, a boiling in phosphate or soda solution is recommended.

Wet-Bright Drawing

The wet-bright drawing itself results from the use of a double

(*Please turn to page* 238)

Wire Rope for the Steel Industry

by

A. J. Morgan, Chief Engineer

Wire Rope Engineering Division

John A. Roebling's Sons Corporation

Trenton, New Jersey

This paper, delivered by the author at a meeting of the American Iron and Steel Institute in Chicago on October 8, 1953, is published here through the courtesy and with the permission of the Institute. In it are described the types of rope constructions used in various parts of the steel industry.

Wire rope has been around quite awhile. A piece was reported found in the ruins of Pompeii, which of course brings the time back into the first century A.D. Also, it has been reported that the ancient Romans made and used wire rope over twenty-four hundred years ago. It is true that the early ropes were reported to have been bronze and, of course, iron entered the picture later on. One of the significant mile-posts in the history of wire rope was the discovery of how to draw steel wire. This was as a result of the development of the so-called patenting process which was simply austinitizing the rod or wire and then cooling in air. This process was patented and has been called patenting ever since. Later on, of course, cooling in lead was developed.

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It is interesting to note that the Brooklyn Bridge was designed to have main cables made of iron wires. Since the drawing of steel wires was developed about the middle of the last century, this came just in time to go into the bridge, and the Brooklyn Bridge cables were made of steel wires rather than iron wires. These wires, which were .182" diameter, had an average strength of 177,000 lbs. per square inch, and an average carbon content of about .70%.

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Wire rope of much greater strength was made of the steel wire. The improvement of steel wire for wire rope came rapidly. Many new industries and machines were designed using this very strong and flexible structure.

★ ★ ★

Higher strength ropes were developed to meet the requirements of farming, and since these ropes were to be used with steam engines to pull plows across the fields, the term "plow steel" was introduced into the wire rope industry. Even today special ropes are made for use in plowing fields.

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The next milestone came around the turn of the century with the introduction of improved plow steel, where a new grade was introduced and a higher strength rope entered the picture. We are still working with that particular grade of rope, but improvements have occurred and are occurring. Many of these improvements have resulted from the introduction of what I like to think of as another milestone in the development of wire rope; namely, the introduction of the carbide die for wire drawing. This came around the early 1930's and did much to materially increase the uniformity and quality of steel wire.

★ ★ ★

During all this time wire rope was increasing its usefulness and entering into practically every industry. Never has there been such a flexible medium with such a high strength to weight ratio, that will go through small clearances, turn innumerable corners and still produce motion economically. In fact when it is necessary to produce motion, a designer would be remiss in his study if he did not investigate whether or not a wire rope would produce the necessary motion in a most satisfactory and most economical manner.

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Wire rope has reached such proportions today that it goes into practically every line of business and endeavor. Our modern cities would not be possible without it. Our airplanes, both airline and private planes, use considerable quantities of aircraft cord; mining and oil field development would without question be retarded, and some of it would not be possible or economical without wire rope. In fact, the use of wire rope extends into any line which you can name. I remember orders going through for the Manhattan Project back in the early days of World War II, when the Manhattan Project meant just exactly that. It was not generally known what it was, or what it contemplated; all that was known around these parts was that it was top priority. It now would seem that we were the only ones in the dark.

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Let's examine this from a slightly different angle, and you may well say that wire rope is a paradox because all of us realize how necessary it is to our modern development. I wonder if we realize that this year over 110 million tons of steel ingots is estimated as the production in these United States while a further estimate places the tonnage that will be fabricated into wire rope at approximately 200,000 tons. In other words, only .2% of the total steel tonnage produced in this country will finally get into wire rope. Without that .2% many operations would have to stop; in fact our whole civilization as we know it, would cease to function in a short time.

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Let's examine more particularly

the use of this giant, wire rope, in the manufacture of steel.

★ ★ ★

Steel in its various and complicated stages of production, originates in the coal and iron ore mines and the limestone quarries.

★ ★ ★

Various and sundry mining practices exist in the excavating of the above three commodities. It can be stated that none of these practices could be as safely and economically accomplished without the aid of wire rope.

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While the mining of coal and iron ore are somewhat similar, there are necessarily some types of equipment used in one that would not be adaptable to the other.

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First let us consider the iron ore mining industry in the Great Lakes area. In this locality the ore is procured generally by two methods; open pit mining and shaft hoist mining. In the former operation the ore body is uncovered by the use of shovels which are equipped with hoist ropes, of varying diameters, which are usually Lang lay, preformed with IWRC construction. Boom hoists, crowd and retract ropes and trip lines are also used on these machines. After uncovering the ore, wire rope again comes into the picture in the form of blast hole drilling lines. These lines usually are 3/4" to 1" diameter 6 x 21 left lay, fiber core, and as their name implies, are used to drill the hole in which the blasting charge is inserted. After the ore is shot, shovels again are employed to load the ore on trains which transport it to the ore-carrying boats.

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The second method, namely, shaft hoist mining, is accomplished through the use of wire rope by hoisting the ore in vertical shafts. Ropes as large as 2-1/4" diameter are used for this purpose, their construction depending upon conditions imposed by the operating equipment, but there is no reason why larger ropes could not be used. The ore as mined by the vertical or incline shaft method, is handled in much the same manner after reaching the surface, as that from the open pits. Upon reaching their destination the ore boats are usually unloaded in one of two ways: boom operated conveyors with which some boats are equipped, or Hulett unloaders. The boom conveyors are operated by a boom line which is usually 6 x 25 construction, preformed, with fiber core. Hulett unloaders equipped with a bucket which reaches into the hold of the boat, are operated by opening and closing lines of 6 x 25 construction, preformed, with fiber core. Other lines such as rotating, larry and beam hoists, are of 6 x 25 construction, preformed, regular or Lang lay.

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After unloading at its destination, the ore is handled by ore bridges which distribute it to the various stock piles. These bridges, which travel on rails, are equipped with buckets using holding and closing lines ranging from 5/8" to 1-1/4" in diameter 6 x 25 preformed, fiber core construction. Trolley lines 5/8" to 1" diameter in the same construction are also employed to manipulate the bucket carriage over the stock pile area.

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Now that we have the iron ore at the steel mill site, let us consider the use of wire rope in the coal mining industry. Three general methods of coal mining are employed; namely, open pit or strip mining, vertical shaft hoist and incline or slope haulage. Wire rope is absolutely vital to all three.

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In the first, large shovels and draglines are used to strip the overburden off the coal. The shovels use, for operating ropes, 6 x 25 to 6 x 49 construction, Lang lay, preformed ropes with IWRC in diameters up to 2-3/8", while ropes up to 2-3/4" diameter will no doubt be used shortly. Ropes up to 4" diameter and strands up to 3-5/8" diameter are being used for boom suspensions today. On draglines the operating wire ropes are also 6 x 21 to 6 x 49 construction. Lang lay, preformed with IWRC, ranging up to 3-1/8" diameter. After the coal is shot, it is loaded by the use of smaller shovels into small capacity cars and large trucks for transport to the tipples for processing and loading into standard railway cars.

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In the second method; namely, vertical shaft hoisting, the coal is prepared underground through the use of mining machines which are essentially cutting and handling machines which use wire rope for forcing the cutter into the coal vein and moving the cutter. The ropes used are 1/2" and 5/8" diameter 6 x 37 preformed with IWRC. The coal is then shot and loaded into mine trains which transport it to the vertical shaft. It is loaded into the shaft skip or onto the shaft cage and hoisted to the surface. Hoisting ropes ranging up to 2" diameter are employed in this service. Here the construction again depends on the operating equipment.

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In the third method, incline or slope haulage, preparation of the coal underground is much the same as the above. The angle of the haulage is governed by the manner in which the coal vein runs in the ground. Haulage ropes vary in diameter, depending upon the load handled and they are usually Lang lay, preformed, fiber core, either 6 x 7 or 6 x 19 construction.

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Sometimes it is necessary to convey the coal in a rope and button conveyor so as to avoid excessive breakage of the lumps. These ropes are usually 3/4" to 1-3/8" in diameter and 6 x 21 or 6 x 25 Filler Wire strands alternately regular and Lang lay with IWRC.

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Frequently coal is transported to its destination by ship or barge. In this case it is delivered to the dock in standard railway cars which are handled in their entirety by car dumpers. The individual cars are spotted in the cradle of the dumper by means of a barney haulage rope. They are then clamped in position for hoisting to the dumping position.

(*Please turn to page* 226)

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Rapid Test for Checking Pickling Rinse Waters

by Isidore Geld
Metal Chemistry Section
U. S. Naval Material Laboratory
New York Naval Shipyard
Brooklyn, New York

A common industrial practice for removing mill scale and rust from steel consists of immersion in hot, dilute sulfuric acid, followed by immersion in fresh water. As a result of drag-out, ferrous sulfate and sulfuric acid gradually accumulate in the rinse water bath. In processes where follow-up immersion treatments such as cyanide neutralization are not employed, sulfates remaining on the steel surface after withdrawal from the rinse water bath tend to accelerate subsequent corrosion. If the steel is subjected to a post-pickle dip in a sodium dichromate-phosphoric acid solution, the presence of sulfates may result in the formation of an objectionable white smut.

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Analyses of rinse waters would indicate when the bath must be discarded, or whether the rate of fresh water flow should be increased or decreased for optimum efficiency and economy. Although laboratory analyses can be made, it would be more advantageous to have additional, simple and rapid, on-location tests performed by pickling personnel. Analyses could be made frequently, several times daily, without the time lag which may occur with more accurate, but slower laboratory methods. The proposed procedure described below is extremely simple and can be performed at the pickling tanks in less than one minute, by nontechnical personnel.

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The procedure is based on a reference point of 1.75 grams per gallon of ferrous sulfate, as higher values were found on 59 out of 61 rinse waters analyzed where the total impurities (ferrous sulfate plus sulfuric acid) reached or exceeded 2.0 grams per gallon. This

(*Please turn to page* 236)

The opinions or assertions expressed in this article are the personal ones of the author and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large. The publishers are grateful to Mr. Geld for his kindness in contributing this practical method of checking rinse waters.

TABLE I

COMPARATIVE DATA FOR LABORATORY AND PROPOSED TESTS

TANK NO.	DATE SAMPLED	MATERIAL LABORATORY ANALYSES			PROPOSED TEST METHOD CONDUCTED BY SHOP PERSONNEL
		FERROUS SULPHATE g./gal.	SULFURIC ACID g./gal.	TOTAL g./gal.	
3R	1/12/55	1.16	0.15	1.31	BLUE
7R	1/12/55	1.16	0.17	1.33	"
11R	1/11/55	1.16	0.58	1.74	
3R	1/14/55	1.71	0.08	1.79	PURPLE
3R	1/19/55	1.14	0.08	1.22	BLUE
11R	1/20/55	1.53	0.36	1.89	"
3R	1/27/55	2.04	0.00	2.04	RED
7R	1/27/55	1.32	0.00	1.32	BLUE
11R	1/26/55	1.44	0.52	1.96	"
4R	2/2/55	0.62	0.00	0.62	"
7R	2/2/55	1.96	0.02	1.98	RED
11R	2/3/55	1.18	0.98	2.16	BLUE
3R	2/9/55	0.39	0.04	0.43	"
7R	2/9/55	1.04	0.18	1.22	"
11R	2/9/55	1.42	1.08	2.50	"
3R	2/16/55	2.24	0.22	2.46	RED
7R	2/16/55	0.67	0.00	0.67	BLUE
11R	2/16/55	0.50	0.00	0.50	"
4R	2/23/55	1.46	0.00	1.46	"
7R	2/23/55	1.46	0.04	1.50	"
11R	2/23/55	0.78	0.14	0.92	"
4R	3/2/55	0.90	0.00	0.90	"
7R	3/2/55	1.38	0.00	1.38	"
3R	3/9/55	4.11 *	0.16	4.27	RED
7R	3/9/55	5.65 *	0.04	5.69	"
11R	3/3/55	0.73	0.00	0.73	BLUE
7R	3/18/55	0.81	0.00	0.81	"
4R	3/23/55	0.29	0.06	0.35	"
7R	3/23/55	0.70	0.00	0.70	"
3R	3/30/55	0.76	0.00	0.76	"
7R	3/30/55	0.43	0.00	0.43	"
3R	4/6/55	0.43	0.12	0.55	"
7R	4/6/55	2.16	0.06	2.22	RED
11R	4/5/55	0.32	0.00	0.32	BLUE
4R	4/13/55	4.65 *	0.14	4.79	RED
7R	4/13/55	1.30	0.04	1.34	BLUE
3R	4/20/55	0.32	0.04	0.36	"
7R	4/20/55	3.57 *	0.06	3.63	RED

* Ferrous Sulfate purposely added.

NOTE: BLUE AND RED SIGNIFY TOTAL IMPURITIES BELOW AND ABOVE 2.0 g./gal., RESPECTIVELY.

Signal Corps Holds Fourth Annual Wire and Cable Symposium

Just 703 persons registered for the 1955 conference on December 6, 7 and 8 at the Berkeley-Carteret Hotel in Asbury Park, N. J.

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Under the slogan "Technical Progress in Communication Wires and Cables", the meeting began at 9:30 A.M. on the first day, continuing through noon of the final day, during which period twenty-five technical papers were presented by Signal Corps and industry technicians.

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The program had been put together by **Howard L. Kitts,** Chief, Outside Plant Branch, SCEL, Program Chairman, and his Co-Chairman, **H. F. X. Kingsley,** Chief, Field Wire and Cable Section, SCEL. Committee members consisted of **R. Blain,** Signal Corps Plant Engineering Agency; **E. J. Burrough,** Du Pont; **P. H. Grogan,** General Cable; **B. Jore,** Anaconda Wire & Cable; **E. L. Love,** Whitney Blake; and **C. T. Wyman,** Bell Telephone Laboratories.

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The opening address of welcome was given by **Brig. Gen. Earl F. Cook,** Commanding General, SCEL, who noted the growth of attendance and interest in these symposia since the first one in 1952 and stating that the object was the production of better wire and cable for the United States' defensive effort. He called attention to the fact that in the last year the term "Coles Signal Laboratory" had been discontinued and replaced by the name **"Signal Corps Engineering Laboratories",** otherwise known as "SCEL".

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Mr. Kitts introduced the technical session, tracing the progress that had been made in the last year. He called attention to the fact that a new alloy containing no nickel, except as a contaminant from scrap, had been developed to replace the old 18-8 stainless steel wire.

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A Nylon formulation used for several years in WD-1 field wire, he said, had never been surpassed, although many concerns had been working to produce a coating with better properties. The great need, he pointed out, is for smaller, lighter wires and better protection to increase the range of serviceability and to facilitate the problem of logistics. Both equipment and wire, he stated, must be serviceable anywhere—from the torrid tropics to the frigid arctic—and for that reason the Signal Corps was always looking for better materials.

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On Tuesday evening, as the guests of approximately 100 industry host companies, a hospitality "hour", lasting about two hours, was held for all those in attendance. Ample supplies of hors d'oeuvres and liquid refreshments were available to the accompaniment of an orchestra. The affair was pleasant and afforded a fine opportunity for the people to get acquainted and to discuss their many mutual problems.

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The big annual banquet was scheduled for Wednesday evening, the second day of the conference. During the dinner an attractive young lady possessed of an accordion and a good voice ran through many of the old songs, in which the men enthusiastically joined.

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Following the dinner, with **E. L. (Eddie) Love** of Whitney Blake as master of ceremonies, those at the head table were introduced, which included the invited guests and the members of the Program Committee. The honored guest of the occasion and the principal speaker of the evening was **Major General James D. O'Connell,** Chief Signal Officer of the United States Army, the seventeenth such leader of the Corps' destinies.

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The General described some of the communication problems of World War I, traced the advances made by the time we had entered upon World War II, the progress made since that time, and outlined what the Signal Corps hoped could be accomplished to meet future needs. These last developments, he confidently asserted, might well be answered by some of the men present, as the Signal Corps leans heavily on industry for the solutions to its many and varied problems. Many of his remarks were illustrated by references to specific circumstances faced by our Armed Forces in the field in the last war.

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General O'Connell closed his talk with a plea to each person in the room to familiarize himself with the Reserve Forces Act of 1955, which, he said, now makes it possible for young men to serve without interruption of either their educational or vocational programs. He made available a booklet setting forth the provisions of the new Act.

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Following the General's speech, the gathering was delighted by a series of highly skilled entertainers, who wound up the evening program on a satisfactory note.

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Mr. Kitts and his committee are to be congratulated on the successful staging of this fourth in the series of symposia that SCEL has sponsored. Representatives from approximately 243 electric wire and cable and supplier companies were in attendance.

Important Technical Advances Made in Heat Treating of Wire in '55

by Carl L. Ipsen
Executive Vice President
Industrial Heating Equipment Association
Washington, D. C.

What the industry is doing in meeting its heat treating problems is a good index to the general attitude toward modernization for more efficient production. Mr. Ipsen prepared this statement especially for Wire and Wire Products.

Last year saw many important advances made in the heat treating of wire and its associated products and the outlook for further improvements to gain increased production and cut costs — especially in the field of mechanization and quality control — is excellent.

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The Association recently made a survey of its member companies who serve the wire and wire products field, asking them what they considered the most outstanding achievements of 1955 and what they believe future trends will be.

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Two trends were cited again and again. One, that increased mechanization is an important step toward cost-reduction. Another, the increased quality control made possible by closer carbon potential control. Automatic equipment which can accurately control the carbon content to within a point or point and a half is now commercially available. Carbon potential control seems to have reached maturity.

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There were numerous important installations and technical advances made during 1955. A few of the highlights include:

1. **Progress in protective atmospheres continues apace with objectionable features such as scale, discoloration, etc., virtually eliminated.**
2. **In several plants mechanization or automation was carried out almost to the ultimate point in that heat treating equipment was linked to other production equipment, eliminating all manual handling, from the previous operation to delivery of the heat treated and tempered material.**
3. **The new application of homogeneous carburizing is being eyed with interest in the wire industry. Low carbon steel can be used, given a boost in carbon content by carburization, and given the strength to meet specifications by heat treating.**
4. **One company has introduced a high convection system of annealing rod and wire coils. It reports this is a modification of the high convection system used for strip steel coils combined with increased fuel inputs and shows a yield of 50% additional capacity without increasing floor space for equipment.**
5. **In one interesting installation, one company reports that a continuous controlled atmosphere pusher furnace has replaced seven older furnaces for annealing a wide variety of steel wire. Depending upon the cycle chosen, the furnace turns out as much as 5,000 pounds per hour of clean decarb-free coils of steels ranging from 1010 SAE to SAE 1080, SAE 52100, and SAE 9254.**
6. **There is increased emphasis on safety features. In the example cited above, the furnace exemplifies this trend, employing a standby purge system to supply non-explosive exothermic generator gas in the event of power failure. The gas would be used to purge the furnace of the endothermic gas used for atmosphere control in the event of power failure at low temperature.**
7. **One company reports that there is a good possibility that the progress of aluminizing iron and steel wire on a continuous basis will spread throughout the industry. Several patented processes using molten salt as a fluxing medium for the aluminum coating of ferrous parts are in the pilot stage and may be expanded to full size units during 1956, the company reports.**
8. **One company reports an interesting case history on the use of an infrared analyzer in reducing decarb rejects. This is another coming trend. Because of its interest, it is set forth in full.**

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A prominent East Coast steel mill was troubled by excessive decarb of wire during annealing. A considerable portion of their output (which varied from 0.03% to 1.1% carbon content) is of screw, lockwasher and ballbearing stock, a rigid specification product on which rejection sometimes reached objectionably high percentages.

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They were scrupulously careful with their exothermic-produced protective atmosphere. An activated alumina tower reduced its dew point to -40 F; an MEA scrubbing tower removed CO_2. They knew the resulting atmosphere fed to their radiant tube cover furnaces should be right, containing about 5% CO, 5% H_2, a trace of CO_2 and the balance nitrogen.

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They double-checked and found dewpoint, H_2 and CO all holding within reasonable limits. This seemed to narrow it down to the trace of CO_2 which they could not check accurately or continuously.

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So they applied an infrared analyzer (range 0 to 2% CO_2), to the task of providing a continuous record of CO_2 in the atmosphere as it left the scrubbing tower. Consistently high readings soon showed that the scrubbing tower and reboiler were the cause of the

(*Please turn to page* 232)

Government Wire Production Information

Spectrographic Standard Samples of Stainless Steel

The National Bureau of Standards has announced the availability of six new standard samples of stainless steel. The samples, carefully analyzed and certified for composition, are designed for calibrating and checking spectrochemical methods of analysis. Together with a set of three spectrographic standards issued earlier, NBS standards now provide certified concentration values for determining most of the elements encountered in the analysis of stainless steels.

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The new stainless steel standards are certified for concentrations of six major and minor elements: manganese, silicon, copper, nickel, chromium, and molybdenum. Samples are available in two forms: rods 7/32 inch in diameter and 4 inches long, and rods ½ inch in diameter and 2 inches long. Both forms serve as electrodes for spark excitation in spectrochemical analysis. The three stainless steel standards issued previously are certified for nine trace elements: aluminum, boron, copper, molybdenum, niobium, lead, vanadium, tungsten, and zinc. These are available in the form of rods 7/32 inch in diameter and 4 inches long.

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Since spectrochemical methods of analysis are both fast and accurate, such methods have been increasingly applied to the analysis of complex steel alloys. Anticipating the growing need of industry for suitable standards, the Bureau began preparing the stainless steel samples several years ago. Six heats of metal were contributed by the Uddeholm Company of Sweden, which prepared the steels to desired composition and fabricated the metal into rods. A grant from the American Iron and Steel Institute assisted the Bureau in homogeneity testing and analysis. Chemical analyses were made by four cooperating laboratories: **Allegheny-Ludlum Steel Corp., Armco Steel Corp., Wilbur B. Driver Co.,** and NBS.

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The rods have a uniform grain structure resulting from hot-rolling and annealing the cast metal. The surfaces of the rods were finished by centerless grinding. The homogeneity of the rods, both in cross and longitudinal sections, was studied by spectrochemical analysis at the Bureau and was found satisfactory with respect to the concentrations of the certified elements.

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The standards can be applied directly to the analysis of stain-

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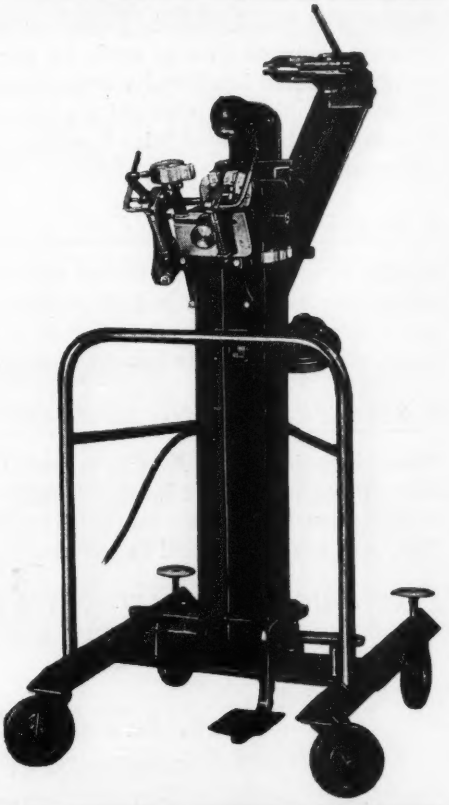

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less steel rods prepared in a similar manner and with similar dimensions. However, when the standards are applied to the analysis of steel samples prepared by other procedures, adjustments may be required to correct for variations introduced by physical differences.

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The stainless steel standards may be obtained from the National Bureau of Standards for a fee of $8.00 each. A provisional certificate supplied with the standards gives average values of the analyses reported by the cooperating laboratories. The compositions and sizes of the standards are given in Table 1. In addition to the elements now certified, the standards also contain aluminum, niobium, tin, titanium, vanadium, and tungsten, some of which may be certified at a later date.

Table 1. Composition of NBS Spectrographic Standard Samples of Stainless Steel

Sample Numbers 1/	Mn %	Si %	Cu %	Ni %	Cr %	Mo %
445	845	0.77	0.53	0.065	0.28	13.30	0.92
446	846	.53	1.20	.19	9.10	18.37	.43
447	847	.23	0.37	.19	13.26	23.73	.059
448	848	2.10	1.25	.16	0.52	9.10	.33
449	849	1.62	0.68	.21	6.62	5.48	.15
450	850	--	0.12	.36	24.8	2.99	--

1/ Sizes: 400 Series, rods 7/32 inch in diameter, 4 inches long
800 Series, rods 1/2 inch in diameter, 2 inches long.

Elgin Names Field Engineer To Serve West Coast Area

The abrasives division of **Elgin National Watch Company** has named **Harold Holsten** field engineer to serve West Coast manufacturers in the metal trades.

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He will operate out of Monrovia, Calif., serving California, Washington, Oregon and Arizona, it was announced by **C. R. Myer,** division manager.

★ ★ ★

Mr. Holsten is trained in precision finishing of metals and the application of Elgin products for the tool industry, including diamond compound, rotary tools, and Elgiloy, the non-corrosive spring alloy.

ABSTRACTS

STAINLESS STEEL WIRE HAS MIRROR FINISH
Nat-Standard Co., Niles, Mich. Iron Age 1955 Vol 176 (14) p 213 (Oct 6)
Special stainless steel wire with lustrous finish, eliminating subsequent polishing, can be drawn from 0.030 to 0.090 in. and has max tensile strength of 250,000 lb/sq in. Only other wire with such finish is diamond-drawn and not normally made in this size range. Wire is free of scratches and flaws and rounder in shape than diamond-drawn wire.

PLASTIC FLOW IN A CONVERGING CONICAL CHANNEL
R. T. Shield. Journ Mech & Phys Solids 1955 Vol 3 (4) pp 246-258 (July)
Flow of plastic-rigid material forced through rigid conical-shaped channel or die considered. Method of solution described for general yield criterion. Particular yield conditions of R. von Mises and H. Tresca considered in detail. Application of theory to wire drawing. 10 illustr, 11 ref.

CONTROL OF WIRE DRAFT: AN EXPERIMENTAL PULLING-POWER GAUGE
O. Hermann. Draht 1953 Vol 4 (10) pp 373-377 (Oct); Wire & Wire Prodn 1955 Vol 30 (9) pp 1025, 1060 (Sep) (Original in German)
See Bibl Ind Diamond Appl 1954 Vol 11 p B27. 2 illustr.

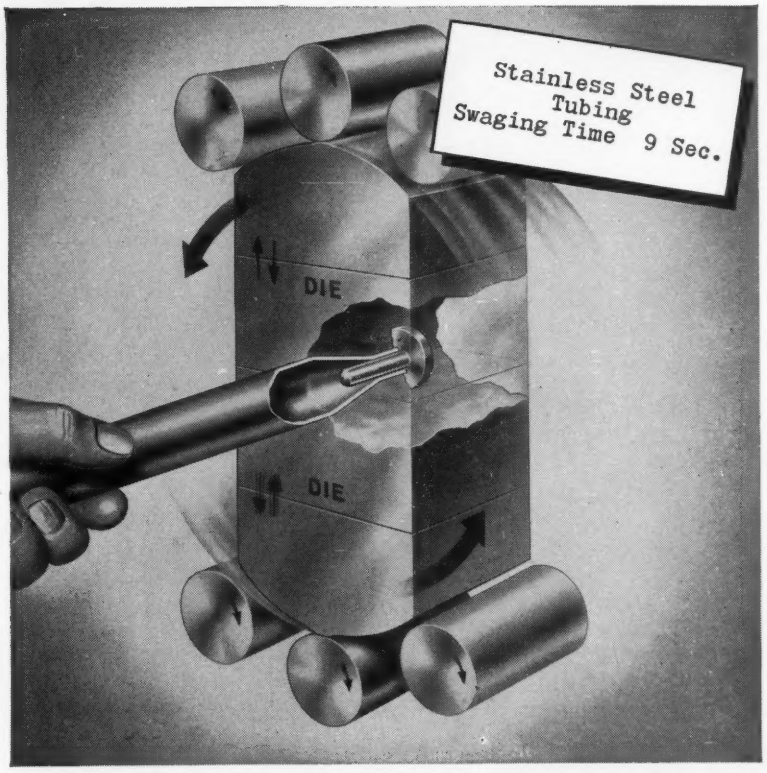
DRAWING FORCE THROUGH DIE. CIRCULAR ARC TYPE DIE AND STRAIGHT LINE TYPE DIE
H. Yamanouchi, I. Hayashi. Wasaeda Univ Rep Castings Res Lab 1954 (5) pp 50-52; abstr Iron & Steel Inst Journ 1955 Vol 181 (1) p 101 (Sep) (Original in English)
Theoretical expression deduced for drawing force in any die formed by revolution of surface; this can be reconciled with experimental values. Min figures occur in drawing stresses for each type of die at certain angles, that for circular-arc type being greater than that for straight-line type.

PLASTIC BEHAVIOUR OF COPPER WIRES AT VARIOUS RATES OF EXTENSION
G. Jastram. Arbeitstag Festkoerperphysik II 1954 1955 pp 82-93; Inst Met Journ: Metall Abstr 1955 Vol 23 (1) col 4-5 (Sep) (Original in German)
Studies on 0.3 mm dia Cu wire.

WIRE DRAWING MACHINES OF HOME PRODUCTION
A. Krzeminski. Hutnik 1954 Vol 21 pp 362-367; abstr Iron & Steel Inst Journ 1955 Vol 181 (1) p 101 (Sep) (Original in Polish)
Polish wire-drawing machines described.

EFFECTS OF GRAIN-SIZE AND LOW TEMPERATURES UPON THE DYNAMICAL FRACTURE OF ALUMINIUM (WIRE)
P. von Roenne. Arbeitstag Festkoerperphysik II 1954 1955 pp 73-76; Inst Met Journ: Metall Abstr 1955 Vol 23 (1) col 1 (Sep) (Original in German)

THE WEAVING OF SPRING STEEL WIRE. WEBEN VON FEDERSTAHLDRAHT
A Jasper. Draht 1955 Vol 6 (11) pp 437-442 (Nov) (In German)
Detailed account of wires suitable for weaving, design of weaving machines, and stresses on wires. 19 illustr.



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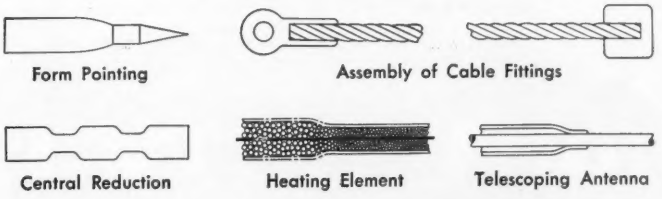
You also save time, material and labor costs . . . greatly increase output . . . in a variety of pointing, tapering, reducing, sizing, forming and assembly operations.

SOME SWAGING EXAMPLES



Check with Fenn for engineering advice on swaging your product or parts.

FENN

Precision Rolling Mills — Turks Heads — Wire Shaping Mills
Swaging Machines — Wire and Tube Drawing Machines

The Fenn Manufacturing Company, 413 Fenn Road, Newington, Connecticut

...and here's why!

Now you can enjoy lower freight charges and greater protection against damage with the new, lighter weight NYECO steel reels. They cost so little more, last 12 times longer than wooden reels, require minimum maintenance. Rugged weatherproof, splinter-proof, warp-proof protection protects costly cable against damage due to dropping, bouncing, rough handling.

Think it over and you'll agree that it doesn't pay to risk an investment of thousands . . . and your reputation . . . on inferior reels.

* These leading mills are just a few of the many that prefer **NYECO** Steel Reels: **OKONITE, ROEBLING, WESTERN ELECTRIC, GENERAL CABLE, ANACONDA, PHELPS DODGE**

- *ANY QUANTITY*
- *ANY SIZE*
- *ANY LOAD*
- *FLANGE DIAMETER From 36" UP*

Write • Phone • Wire

NYECO

Specialists to the Wire Industries for Over 45 Years

NEW YORK ENGINEERING COMPANY

75 West Street, New York 6, N. Y.

TELEPHONE: WHitehall 4-5380 **CABLE:** NYECO, N. Y. **PLANTS:** YONKERS, N. Y.

GERMAN STANDARDS: SIEVES, ROUND WEAVING WIRE. DIN 4186. SIEBE: WEBERDRAEHTE RUND
Anon. Draht 1955 Vol 6 (11) pp 472-473 (Oct) (In German)
Draft of new German standard DIN 4186, Sheets 1 and 2, giving dia of wires from 0.02 to 12.5 mm, with permissible tolerances for usual sieves of steel and non-ferrous metals, and test sieves including data on testing and conditions of delivery.

These abstracts are published through the courtesy and with the permission of the Industrial Diamond Research Bureau, 34, Holborn Viaduct, London, E.C.1, England. Inquiries regarding them should be directed to the Bureau.

New Booklet on "Mylar"

A new booklet showing latest commercial uses and detailed physical and chemical properties of "Mylar" polyester film has been issued by **Du Pont's** Film Department.

★ ★ ★

Illustrated by numerous photographs and charts, the booklet cites many examples of industries where this versatile plastic film has now become a preferred material.

★ ★ ★

Included is an easy-to-read chart detailing the characteristics of "Mylar". These properties include insensitivity to moisture, resistance to solvent and chemical attack, wide temperature operating range, plus greater tensile strength than any other plastic film.

★ ★ ★

Copies of Booklet MB-4 may be obtained from the Du Pont Film Department, Wilmington 98, Delaware.

Rome Cable Film Tells Story of Its People

Two years ago **Rome Cable Corporation** sponsored a motion picture film, "Cable . . . Pathway of Power" (42 minutes) designed to show prospective customers and engineers how cable is made at Rome. Emphasis was placed upon manufacturing facilities and the product itself.

★ ★ ★

Believing that the people behind

the product are one of its biggest assets, the company has now completed a companion film, "Cable Makers" (21 minutes) which undertakes to tell that story. While "Cable Makers" has much to say about cable making, such technical aspects are interwoven with personalities of the people who are Rome Cable. Background to the story is Rome itself with intimate human interest shots.

★ ★ ★

Both films are 16 MM, sound and color. Prints are available on a free loan basis from the Advertising Department, Rome Cable Corp., Rome, New York.

Bulletin on Brazing

A new bulletin on low temperature brazing, using silver brazing alloys, has been issued by **Handy & Harman,** 82 Fulton St., New York 38, N. Y.

★ ★ ★

For a copy write to the company asking for Bulletin No. 70.

Scientist Develops New Microscope Technique

By using an X-ray-sensitive recording material which exhibits no grain under the electron microscope, **W. A. Ladd, Ladd Research Industries, Inc.,** Roslyn Heights, N. Y., produces micrographs that show overlapping lead particles and similar structure details previously indiscernible.

★ ★ ★

One recording material is a copolymer of polyvinyl chloride acetate. Known on the market as "rigid vinyl", it is purchased in sheets of 10 mil thickness. In the case of 200-mesh lead particles, they are taped securely with the vinyl to the window of an X-ray diffraction tube.

★ ★ ★

After exposure for 23 hours at 9-10 kilovolts, 20 milliamperes, the vinyl is developed in a 30% acetone-in-water solution for 30-60 minutes. This produces a vinyl relief from which replicas can be made for use in the electron microscope.

★ ★ ★

NOW ...Wire of High Finish for Electroplated Products in Many Shapes & Sizes

Bright, Smooth No. 3 Finish takes Plating Beautifully—Adds Eye-Appeal to Your Products

Continental's new technique for producing #3 finish flat and special shaped wire offers you a range of standard and special wire shapes with a satin smooth finish for electroplating purposes. Previously, only flat wire with a surface suitable for high polish electroplating was obtainable...but now from Continental you can specify #3 finish in flat, square, rectangular, oval, and other shapes on inquiry, in practically any size, temper, and analysis in low carbon and medium low carbon steels. (Note—some sizes of above shapes require special tooling before they can be produced.) Here is extra "eye-appeal" for moldings, product trim, or wherever a formed plated wire component is required. Send us a blueprint of your part, or mail the coupon today.

SPECIALISTS IN WIRE
FOR OVER HALF A CENTURY

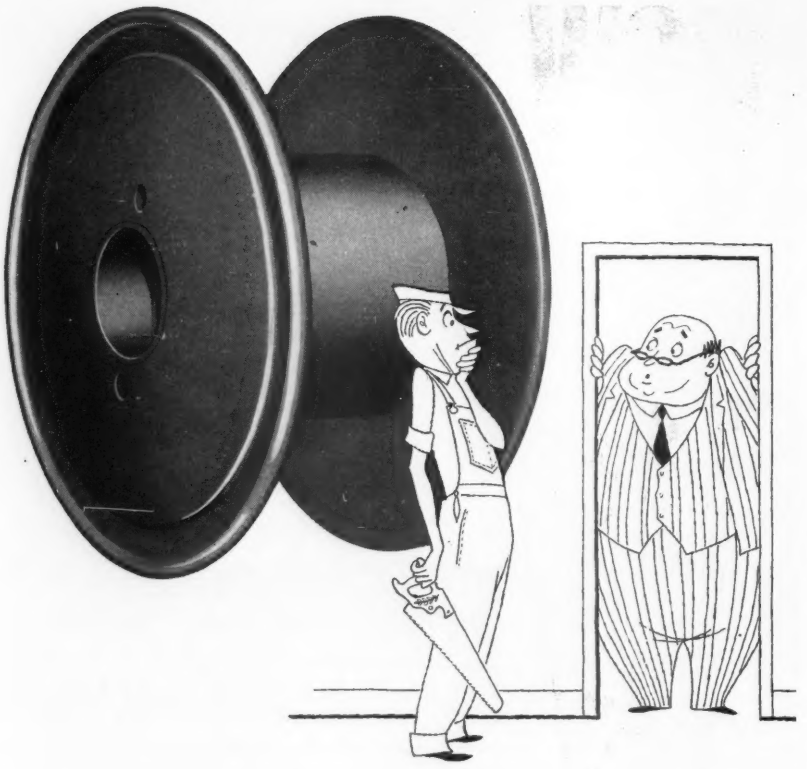
CONTINENTAL
STEEL CORPORATION
KOKOMO, INDIANA

PRODUCERS OF:
Manufacturer's wire in many sizes, shapes, tempers and finishes, including Galvanized, KOKOTE, Flame-Sealed, Coppered, Tinned, Annealed, Liquor Finished, Bright, and special wire. ALSO, Coated and Uncoated Steel Sheets, Nails, Continental Chain Link Fence, and other products.

FILL OUT AND MAIL TODAY

Gentlemen: Please send us complete information concerning the new Continental #3 Finish Wire for Electroplating.

NAME_____
TITLE_____
FIRM_____
ADDRESS_____
CITY_____ ZONE____ STATE_____



SPECIAL REQUIREMENTS
need special attention . . .

When your specifications for steel reels, spools, and bobbins call for *special* attention to the details of size, shape, trueness, and balance . . . call on Apco Mossberg. Backed by over 50 years of specialized service to wire and wire rope manufacturers, our engineering and service departments will submit recommendations, without obligation, that are custom-tailored to fit your needs. Write today, or call collect . . . Attleboro 1-0340.

Ask For Our Booklet Containing Information On:

Flat Head Spools — Take Off Reels
Curled Flange Spools — High Speed Wire Drawing Reels
Stranding Reels — Vulcanizing and Insulating Reels
Pressed Steel Bobbins for Wire Weaving

Pacific Coast Representative:
Gordon Proffitt
Room 501-503
24 California Street
San Francisco 11, Calif.

Canadian Representative:
Hugh P. Williams & Co.
47 Colburne Street, West
Toronto, Ontario, Canada

(The original Frank Mossberg Co.)

APCO MOSSBERG COMPANY
ATTLEBORO, MASS.

This new X-ray technique greatly broadens the versatility of electron microscopes in biological and industrial applications. Mr. Ladd employs Norelco equipment but the method can be utilized in any laboratory where an electron microscope and suitable X-ray generators are available.

Canada Wire & Cable Building New Plant

Canada Wire & Cable Company, Noranda Mines subsidiary, has started construction on a Winnipeg, Man., factory to adjoin a plant being built by **Telecables & Wires, Ltd.,** a subsidiary of Canada Wire, **General Cable Corporation** (U. S.) and Telegraph Construction & Maintenance of Britain. The two plants will cost $2 million plus, of which the Canada Wire unit will represent $1 million.

★ ★ ★

Besides its own lines, the Canada Wire plant will do custom drawing of copper for Telecables.

Carbide Die Concern Moves to Larger Quarters

Allied Manufacturing Co., Inc., formerly located at 1 Jackson St., Worcester, Mass., has purchased and moved into a fine, modern building at 50 Milbrook St., in the same city.

★ ★ ★

The company, now in its 13th year, manufactures tungsten carbide wiredrawing dies and tools, doing a national and international business. It is headed by **B. C. Paharik,** President, and **William J. Maher,** Vice President.

★ ★ ★

The building stands on a 5 acre plot, is all on one floor for manufacturing operations and has a two story section of offices. Ample parking facilities are available for visitors.

Correction

At the bottom of page 70 in the January issue, in the Calendar of 1956 Wire Association Meetings, it was erroneously stated that the Pacific Coast Meeting would be held in San Francisco. The 1956 Regional Meeting on the West Coast will be in Los Angeles.

*Removal of Scale Dust by Electric Induction Current

A recently patented apparatus of the Rätz System accomplishes the removal of the fine residual scale dust that has remained after the mechanical descaling by roller machines, that adulterates the stearates in the lubricant boxes.

★ ★ ★

The apparatus attaches readily to the existing mechanical descaler. The wire passing through is subjected to a magnetic field and is vibrated inductively in such a manner that the fine particles of scale are loosened and detached. By a feature of this arrangement of spools, the loosened fine particles are magnetically homopolarized, which has as a result their temporary support on the wire. They can be deflected after leaving the field of force and then they fall by force of gravity.

★ ★ ★

One feature of this method can be mentioned that is of decisive importance. Until now the surface of the wire indeed was somewhat cleaned by the steel wool in the cleaning boxes, but the rough surface was rubbed smooth. With the scale dust removed by application of this new method, the surface of the wire remains porous, so that the stearate can be evenly distributed over the surface and because of the roughness a certain adhesion results that causes the stearate to build up a film layer.

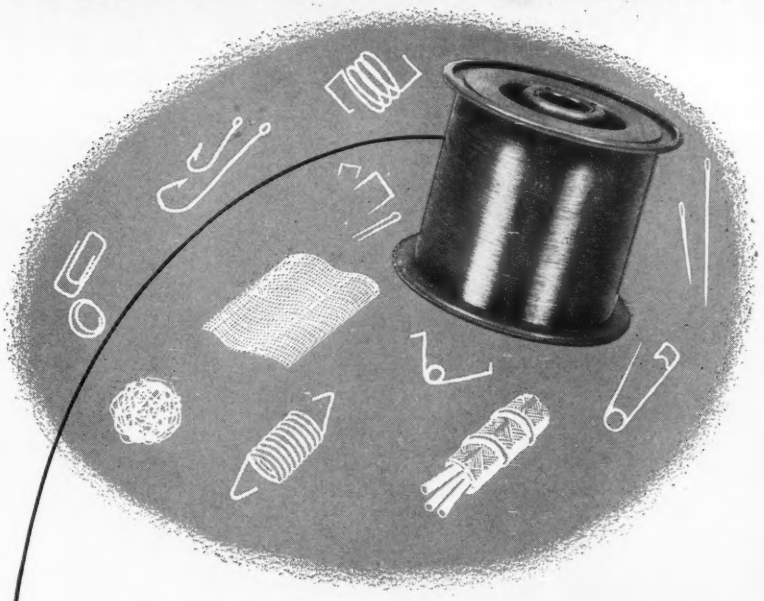
★ ★ ★

The vibration to which the wire is subjected during the course of the drawing causes, with the different stearates, an additional take-up of the lubricants with avoidance of the dreaded tunnel effect. This means that by increasing the take-up of lubricant, with simultaneous removal of the finest particles of scale, the wire runs through the die with a clean lubricant, and in multiple drafting, produces a surface quality and cleanness not heretofore possible.

★ ★ ★

* From the October 25, 1955, issue of Draht Welt, translated by Jerome W. Howe, Worcester, Mass.

FOR FINE WIRE PRODUCTS . . .



Almet Stainless Steels

MEET MORE REQUIREMENTS
THAN OTHER ENGINEERING MATERIALS

Does your Fine Wire application call for resistance to heat? . . . to corrosion? Does it require good fatigue properties . . . excellent weaving or other forming characteristics? There's a good chance you will find the material you need among the more than 20 grades of stainless steel we fabricate into high quality Fine Wire. No other family of metals has the combination of properties common to the stainless steels.

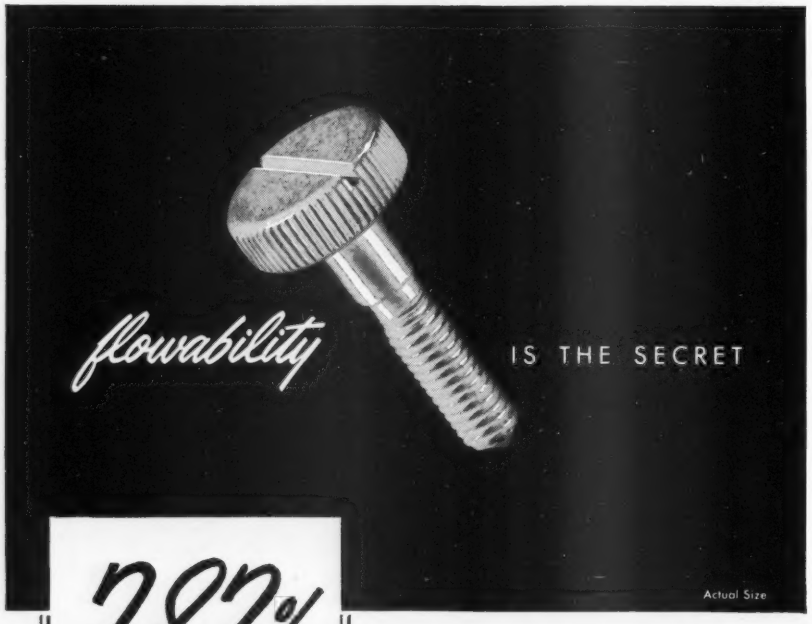
Learn more about the interesting properties and applications of our stainless steel Fine Wire, as well as our stainless Rod and Strip . . . send today for a copy of our new 40 page Stainless Steel Design Handbook.

ALLOY METAL WIRE DIVISION

HKP
A DIVISION OF H. K. PORTER COMPANY, INC.

H. K. PORTER COMPANY, INC.
Prospect Park, Pennsylvania

KEYSTONE XL COLD HEADING WIRE



282% MATERIAL SAVED...

USING KEYSTONE XL COLD HEADING WIRE

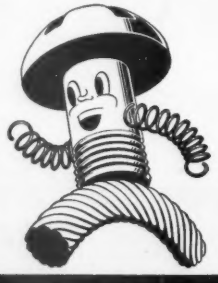
This circuit breaker part was machined at one time. But, cold-heading experts analyzed its design and decided that it could be successfully formed from Keystone "XL" Cold Heading Wire. The result—a material waste reduction from 75% to 7%—and a saving of 282% in steel, plus faster, lower cost production and a finished product that is stronger and free from defects.

Keystone "XL" Cold Heading Wire is not just ordinary cold heading wire. It is wire made to your specific order to exactly solve your difficult cold heading problems. Special drawing, annealing and coating "secrets" produce a wire of exceptional *flowability*. Originally developed for recessed head screws, Keystone "XL" Wire is now widely used to solve many of the toughest cold heading problems at great savings in time and money.

SEND FOR FREE "COLD HEADING" BOOKLET

Get your copy of a new, valuable reference book containing many technical and informative facts about the modern cold heading process. Remember, too, that Keystone specializes in all types of wire for all types of industrial needs. Write us about *your* need!

KEYSTONE STEEL & WIRE COMPANY, PEORIA 7, ILLINOIS



KEYSTONE WIRE *for Industry*

As is well known, the surplus lubricant in subsequent galvanic or electric treatment (particularly welding of structural steel mesh) has very damaging accompanying effects, as the excessive grease-film smears the welding area and consequently, not till after repeated cleaning of the points of contact, is an acceptable weld possible.

★ ★ ★

The inductive descaling as a supplement to customary mechanical descaling shows results that correspond to chemical descaling.

★ ★ ★

The inductive descaling device of the Rätz System has German patent applied for under No. R-17040 1b/7a.

Booklet on Special Metal Producing and Processing Service

A special service to the metallurgical industries—the production and processing of made-to-order metals in experimental quantities—is described in a 16-page booklet just released by the Allied Products Division of Hamilton Watch Co., Lancaster, Pa.

★ ★ ★

Entitled "Precision Metals Services," the illustrated booklet describes the facilities of Hamilton's unique and complete pilot plant for producing small (10-pound) ingots by regular or vacuum melting, and for forging, annealing, heat treating, rolling and drawing the resultant metal. Highlights of this service which the booklet points out are: 1) Complete laboratory control for all steps in producing the metal; 2) Special facilities for rolling strip down to only .00025-inch thick; and 3) Special furnaces and processes for heat treating small parts to produce a bright surface and prevent distortion. The booklet also includes a list of other special metal producing and processing functions which the service will provide.

★ ★ ★

For copies of the booklet write to **Claude E. Disney,** Sales Manager, Allied Products Division, Hamilton Watch Company, Lancaster, Pa.

Outstanding Personalities of the Wire Industry

Continental Can Appointments

The board of directors of **Continental Can Company** has elected **Thomas C. Fogarty** president of the company, effective Jan. 1, to fill the vacancy created on that date by the retirement of **Hans A. Eggerss,** it was announced by **General Lucius D. Clay,** chairman of the board.

★ ★ ★

He also announced three other Metal Division promotions, effective on that same date. **Reuben L. Perin,** vice president of the Eastern Division, has been elected executive vice president of the Metal Division, the position held by Mr. Fogarty since 1950.

★ ★ ★

Orren R. McJunkins, general manager of the Southeastern District, has been promoted to vice president in charge of the Eastern Division, and **Horace M. Blinn,** general manager of the California District of the Pacific Division, has been elected vice president in charge of that division to fill the vacancy that will be created by the retirement of **Sherlock McKewen.**

ACP Appoints Director of Marketing

John O. J. Shellenberger, Vice-President, has been appointed Director of Marketing of the **American Chemical Paint Company,** Ambler, Pa. The appointment was announced by **Leon Cherksey,** President.

★ ★ ★

In his new capacity, he will supervise sales and marketing activities of the firm's three main divisions: Metalworking Chemicals, Agricultural Chemicals, and the International Division. He carries into this new position a background of 20 years' experience in metalworking and agricultural chemicals, both at home and abroad.

★ ★ ★

Mr. Shellenberger joined ACP in 1935 as Advertising Manager. During World War II on a leave of absence, he served a tour of duty with the U. S. Navy, attaining the rank of Lt.-Commander. Upon his return to the Company in 1946, he became Manager and then later Vice-President and Director of the International Division.

Crucible Elects Two Vice Presidents

The Board of Directors of **Crucible Steel Company of America** has elected **James D. Glenn** Vice President of Sales and **Maurice J. Day** Vice President of Research and Development, according to an announcement made here today by **William P. Snyder, Jr.,** Chairman.

★ ★ ★

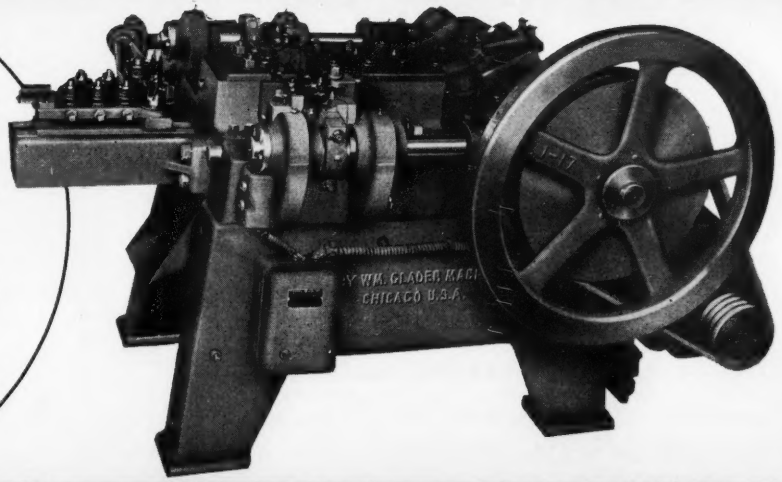
GLADER

HIGH SPEED WIRE NAIL MACHINES

HIGH TONNAGE OUTPUT—LOW MAINTENANCE COST

You can take care of increased production schedules and better product demands with these machines of established reputation.

For 55 years GLADER MACHINES have been giving HIGH QUALITY, LOW COST nail production.



Wm. Glader Machine Works 210 N. Racine Avenue Chicago 7, Illinois

Export Dept.: 122 E. 42nd Street, New York 17, N. Y.

Mr. Glenn was formerly General Manager of Sales for Crucible. Dr. Day has been the Company's Director of Research and Development.

★ ★ ★

Both will continue to maintain offices at Crucible headquarters in the Oliver Building, Pittsburgh, Pa.

Celanese Makes Staff Changes

Celanese Corporation of America has announced several staff changes in the organization of its Summit Research Laboratories, Summit, N. J.

★ ★ ★

Dr. Bruce B. Allen, formerly laboratory manager and director of research, has been named technical director of the Celanese Textile Division at Charlotte, N. C. He will succeed **Dr. Robert T. Armstrong,** who was recently elected vice president-technical director of the company.

Under the new organizational set-up at the Summit laboratories **Samuel B. McFarlane** will serve as laboratory manager. He will be in charge of the research facilities and services provided by the Summit laboratories for the three operating divisions: Textiles, Plastics and Chemicals.

★ ★ ★

Dr. Oren V. Luke, Jr. is the new manager of the Plastics Research Department. He was transferred to Summit in 1954 from the Celanese Petroleum Chemicals Research and Development Laboratories in Clarkwood, Texas.

★ ★ ★

Dr. Russell O. Denyes, was named manager of the newly-created Fiber Research Department. He came to Summit in 1949 from the Celanese plant in Rome, Georgia, where he had been assistant manager of textile process research.

★ ★ ★

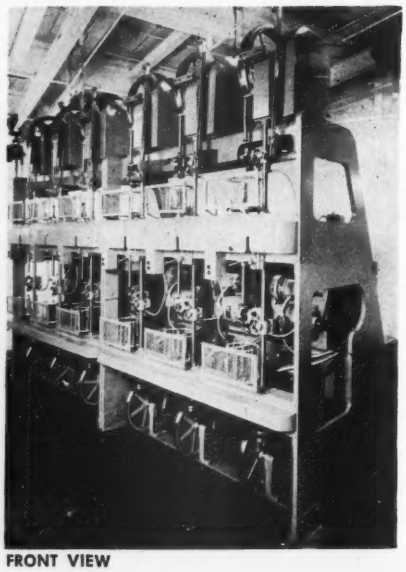
A fourth change in the Celanese staff is the appointment of **Dr. Michael J. Curry,** as manager of the Celanese Chemical Division's Application Laboratory at Summit.

Paper Concern Announces Sales Realignment

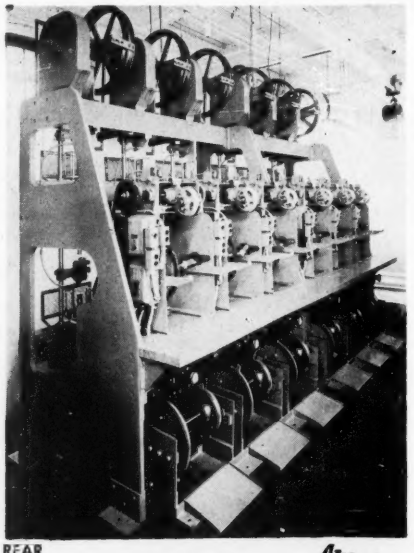
Due to the retirement of **Howard R. Campbell, National Waterproof Papers, Inc.,** Beverly, N. J., has realigned its sales territories.

★ ★ ★

Bernard D. Pasahow, general sales manager, has announced the transfer of **A. J. (Al) Hart** to the Philadelphia area, who will assume responsibilities formerly handled by Mr. Campbell. Mr. Hart will represent National Waterproof Papers on all of their products, which include plain and reinforced laminated papers, creped kraft paper products and packaging specialties, sewn liners and sleeves, as well as tufpak creped multi-wall bags.



FRONT VIEW



REAR

3D-6-MBB TAPING MACHINE #1107

Applies double cover to 6 lines of wire simultaneously. Nominal wire range #6 to #18 B & S gauges (.162" to .040" or 4.116 MM to 1.024 MM). Standard Capstans 24" in diameter. Supply wire let-offs and torque motor driven take-ups for 24" diameter reels are at rear of machine.

EST. 1855 AIMco INC. 1915

"American" AIM INSULATING MACHINERY COMPANY

REG. U.S. PAT. OFF.

FAIRHILL AND HUNTINGDON STREETS

PHILADELPHIA 33 PENNSYLVANIA U.S.A.

Joins Morgan Construction

Lawrence J. Woods Jr. has joined the **Morgan Construction Company,** Worcester, Mass., as engineer in the Wire Machinery Division. Recently he acted as consultant to the **Revere Corporation of America** and other organizations in the wire field. Prior to that time Mr. Woods served with the A.U.S. Ordnance Department and the **Spencer Wire Company,** where he rose to the post of Vice President and General Manager of the steel wire operation.

★ ★ ★

Mr. Woods received his C.B.A. from Boston University in 1941. He is a member of The Wire Association.

Executive Shifts Announced by Young Spring and Wire

Three top-level appointments in the **L. A. Young Spring & Wire Corporation,** Detroit, Mich., have been announced by **N. D. Ely,** president. **Thomas Couper** has been elevated from vice president to general vice president; **Peter J. Gallette** from general sales manager to vice president, automotive sales; and **Russell B. Robins** from director of marketing to vice president-marketing.

Joins Atlantic Wire as Production Manager

Renato A. Rodriguez, formerly with the **Gulf Steel and Wire Company** in Puerto Rico, has joined the operating staff of **The Atlantic Wire Company,** Branford, Conn., as Production Manager, according to an announcement by **W. E. Hitchcock, Jr.,** President. Prior to that Mr. Rodriguez had been associated with the **Bethlehem Steel Company** in Johnstown, Pa.

To Represent Entwistle in New England

Frederick L. Erminelli has been appointed New England Representative to represent the **James L. Entwistle Co.,** Providence 7, R. I., on its entire line of wire processing machinery and supplies, according to an announcement by **Alvin R. Corkin,** Vice President.

★ ★ ★

Mr. Erminelli has had ten years experience with the JLE line and is familiar with the problems of insulated wire production. He is a graduate chemist and a member of the ASME and the Providence Engineering Society.

Pigment Concern Appoints Sales Manager

The appointment of **Edward T. Butler** as General Sales Manager of **Acheson Dispersed Pigments Co.,** Philadelphia, Pennsylvania, a unit of **Acheson Industries, Inc.,** has been announced by **J. S. Thome,** Vice President — General Manager.

★ ★ ★

Mr. Butler was formerly Sales Manager of the Plastics Division, Diamond Alkali Company. He has a background of many years in the plastics and protective coating

SEE THE DIFFERENCE YOURSELF...
BETWEEN JUST ANY SPOOL AND
Superior MPS
NO-CREV SPOOLS
No-Crev Spools eliminate the conventional crevice at the inner junction of spool head and barrel. No more production slow-ups due to fine wires getting caught in such a crevice. You can now have continuous trouble-free high speed winding.
We invite your inquiries — let us tell you more about No-Crev Spools. Write us today.
MPS
NO-CREV SPOOLS
give you brute strength with dimensional precision, concentricity, and balance. Another patented MPS development engineered to help you!
Mossberg PRESSED STEEL Corporation
18 WEST ST., ATTLEBORO
MASSACHUSETTS, U. S. A.
Telephone Attleboro 1-0848
#108

industries and has been engaged for his entire business life in various capacities in these fields.

★ ★ ★

Acheson Dispersed Pigments Co. maintains plants in Philadelphia, Pa., their headquarters, Orange, Texas, and Delaware, Ohio. The company manufactures a complete line of dry and paste color dispersions and all types of plastic printing inks.

Named Works Manager of Riverside Metal

David K. Davis has been appointed works manager for the **Riverside Metal Company** division, **H. K. Porter Company, Inc.,** according to an announcement made by **W. Harvey Thompson,** vice president and general manager.

★ ★ ★

Mr. Davis comes to Riverside from the New Haven plant of Western Brass Mills where he was assistant plant manager, Metals division. He is a graduate of the University of Illinois with a degree in metallurgical engineering and has spent 15 years in the brass mill business.

★ ★ ★

His experience includes positions as: mill metallurgist, general foreman — cast shop and production control, assistant superintendent, superintendent and assistant plant manager.

★ ★ ★

As works manager, Mr. Davis will be in charge of all manufacturing personnel. Henry S. Freynik, vice president-metallurgy, will be in charge of all quality control and laboratory personnel.

★ ★ ★

Riverside is currently undergoing a $1,500,000 modernization and expansion program.

ACCO Promotes George W. Herman

It has been announced by the **American Chain & Cable Company, Inc.,** Bridgeport 2, Conn., that **George W. Herman** was recently appointed to the position of Assistant Plant Manager of the Bridgeport plant. Manufacturing facilities for the Campbell Machine Division, Helicoid Gage Division, Owen Silent Spring Division and the Wilson Mechanical Instrument Division are maintained at Bridgeport.

★ ★ ★

Mr. Herman is a graduate of Cooper Union School of Engineering, New York, N. Y. and was first employed by the Wilson Maeulin Company, New York in October 1929 and with the Wilson Mechanical Instrument Company in November 1932. Wilson Mechanical Instrument Company became a division of the American Chain & Cable Company, Inc., in 1944.

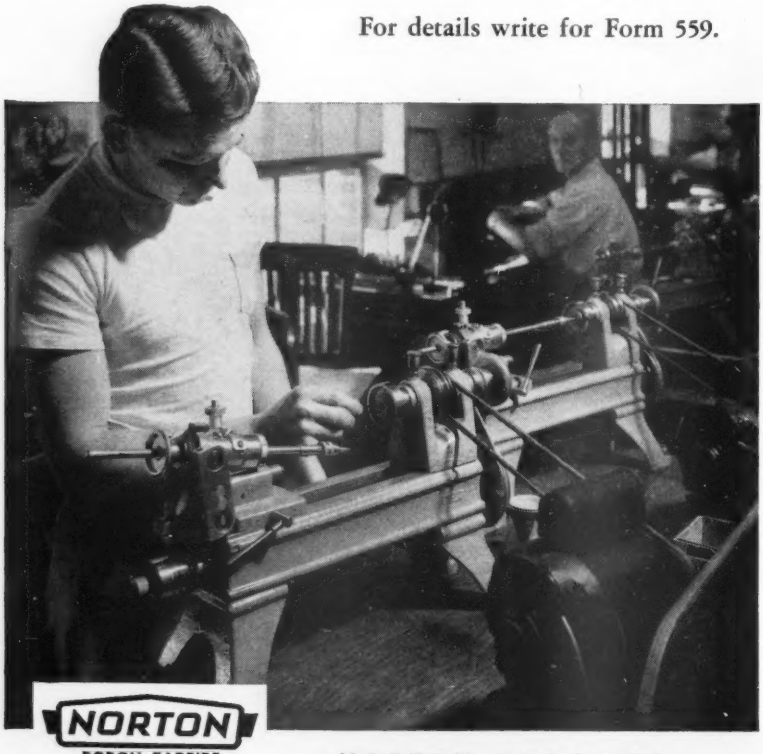
New Laboratory Head Appointed at Nopco

The Nopco Chemical Company Harrison, N. J., has announced the appointment of **Dr. Charles A.**

Save Money with NORBIDE® Abrasive . . .

Are you still using costly diamond dust for refinishing your wire drawing dies? Many wire mills are saving money by using NORBIDE Abrasive for ripping or fast stock removal as well as for accurate semi-finishing operations.

For details write for Form 559.



NORTON BORON CARBIDE

NORTON COMPANY
45 New Bond Street • Worcester 6, Massachusetts

NORBIDE® . . . *the hardest man-made abrasive*

Fetscher as Director of its Industrial General Laboratory.

★ ★ ★

In his new position, Dr. Fetscher will be in charge of all research activities pertaining to the development of new products for Nopco's Industrial Division. These products include synthetic organic chemicals and industrial processing specialties for such diverse industries as the manufacture of paper, leather, textiles, paint, lubricants, cement, detergents, and adhesives.

★ ★ ★

A graduate of Holy Cross College, Dr. Fetscher received his Ph.D. in organic chemistry from Columbia University.

Mann Succeeds Garber at Alloy Metal Wire

Lawrence L. Garber, Vice President, has been named General Manager of the new Disston division. He was General Manager at the Alloy Metal Wire Division, Prospect Park, Pa. Succeeding him as General Manager at Alloy will be **Emmett Mann,** formerly Sales Manager. Mr. Mann has been elected a Vice President. He has been with Alloy Metal Wire for six years, starting as a sales engineer.

Wire Concern Elects Officer

Clifford Faust has been elected Vice President of **National Wire Products Corp.,** Baltimore 22, Md., at a recent meeting of the board of directors.

★ ★ ★

Mr. Faust will direct National Wire's expansion program which is aimed at keeping pace with accelerating demand for welded wire concrete reinforcement mesh in the East. He has many years experience in the design and installation of wire working equipment.

Firth-Loach Appoints Chief Engineer

John Gabrenas has been appointed Chief Engineer of **Firth-Loach Metals, Inc.,** McKeesport, Pa., it has been announced by **L. Gerald Firth,** President.

★ ★ ★

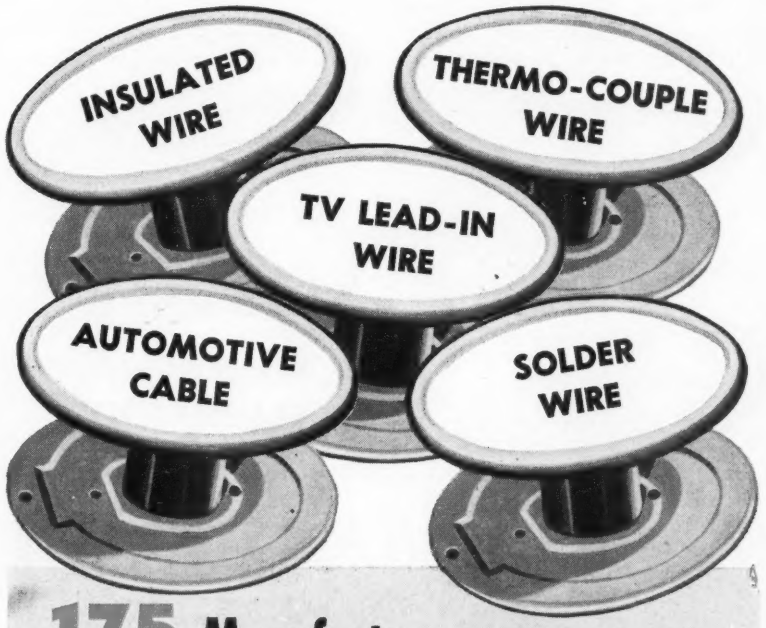
Mr. Gabrenas brings to his new post a wide background of experience in carbide applications. He was previously associated with **Firth-Sterling Steel Company** as Assistant Chief Engineer from 1948 to 1955. Prior to that he was Tool Supervisor for the Douglas Aircraft Company at Park Ridge, Illinois.

★ ★ ★

Firth-Loach Metals, Inc. manufactures a complete line of cemented carbides for metalworking and other industrial applications.

LaSalle Steel Appoints Purchasing Agent

The appointment of **Thomas J. Moore, Jr.,** as Director of Purchases for the **La Salle Steel Company** of Chicago, Illinois, has been announced. In addition to purchas-



175 Manufacturers say MASON Spools are best—for less!

These manufacturers specify Mason lightweight, non-returnable, lithographed Spools for performance, appearance and cost!

And while Mason Spool performance speaks for itself, the appearance of Mason Spools speaks for *you* with rich, colorful lithography that assures *instant brand recognition.*

Mason lightweight, non-returnable Spools are available in 5″, 6½″, 8½″ and 10½″ head sizes. All sizes are available with 1⅜″ (Dia.) barrels. The 10½″ head size is also available with a 3½″ (Dia.) barrel. Barrel lengths from ⅝″ to 14″.

Let us know about your spool requirements *now!* Telephone East Providence 1-2810 or write to the address below.

MASON CAN COMPANY

1949 Dexter Road, E. Providence 14, R. I.

Branch Plant — Greenville, Ohio

ing, he will also direct material and production planning.

★ ★ ★

Mr. Moore comes to La Salle from Washington, D. C., where he has just completed an assignment as Director of the Iron and Steel Division, Business and Defense Services Administration, U. S. Department of Commerce.

ACCO Appoints Administrative Assistant

Announcement has been made that **William B. Ilko** has been appointed Administrative Assistant to **Henry Ervin,** Vice President and Director of Sales, **American Chain & Cable Company, Inc.,** 230 Park Ave., New York, N.Y.

Chase Brass Appoints Sales Executive

George B. Moseley, of Akron, Ohio has been appointed vice president in charge of sales for **Chase Brass & Copper Co., Inc.,** a subsidiary of **Kennecott Copper Corporation,** it has been announced by **Richard C. Diehl,** president of Chase.

★ ★ ★

Mr. Moseley comes to Chase from the Firestone Steel Products Company of the Firestone Tire & Rubber Company, Akron, O., where for the past seven years he has been general sales manager. Earlier in his business career he was chief service engineer for Jack and Heintz, Inc., in Bedford, O., and served Lincoln Electric Company, Cleveland, in a sales capacity. From 1946 to 1949, he was sales manager of the Contract Manufacturing Division of the Hupp Corporation, Cleveland. He succeeds **Bruce A. Dean** as head of sales for Chase, who resigned this position in November.

Wire Man Named Chairman Federal Reserve Bank of Boston

R. C. Sprague, founder and chairman-of-the-board of the **Sprague Electric Company,** North Adams, Mass., has been named chairman of the Federal Reserve Bank of Boston and its fiscal agent.

★ ★ ★

Well known in the electronics industry, Robert Sprague is the former president and chairman-of-the-board of the Radio-Electronic-Television Manufacturers' Association. He founded the Sprague Electric Company in 1926 in Quincy, Mass., while a Lieutenant in the U. S. Navy, resigning from that service in 1928 to devote his full time to the business. The firm moved to North Adams in 1930, and presently has ten plants employing some 6,000 persons across the nation.

Walter B. Lashar

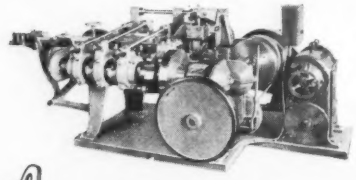
Walter Benjamin Lashar, 85, for over 50 years an outstanding figure in Bridgeport's industrial and banking fields, died last November. Mr. Lashar retired from active business activities in 1950.

★ ★ ★

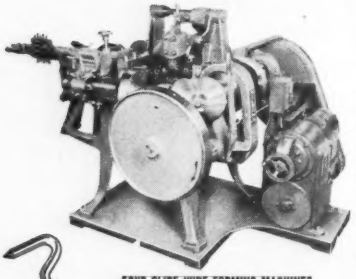
During his long career as an industrialist Mr. Lashar served as first president of the **American Chain Company,** which he helped to organize. He held executive positions in the Connecticut National Bank of Bridgeport and other organizations.

★ ★ ★

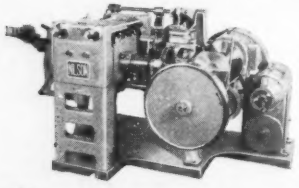
Mr. Lashar was born in Bridgeport, September 30, 1870.



COMBINATION PRESS AND FOUR-SLIDE FORMING MACHINES
Available in 4 Models.
Features Built-In Crank Press
Feed capacities: 8, 10, and 15 inches
Press capacities: 8, 12, 20, and 30 tons
Max. width of stock: 1¼, 1½, 2, and 2½ inches, as std.
Stroke of press: ⅝, ⅞, 1, and 1¼ inches
Net weights: 2560 to 9700 lbs.



FOUR-SLIDE WIRE FORMING MACHINES
Built-In 10 Models Rated By Wire Capacity Will Form Ribbon Metal Also
Wire diameters formed: approx. 1/64 through ½ inch
Feed lengths available: from 3 to 32 inches
Net weights: from 600 to 18,500 lbs.



HEAVY DUTY COMBINATION FOUR-SLIDE MACHINES
Available in 2 Models.
Features Built-In Toggle Press
Press capacities: 50 and 75 tons
Max. feed lengths: 11½ and 16 inches
Max. width of stock: 2 and 2½ inches
Stroke of press slide: 2 and 2½ inches
Net weights: 9535 to 12,700 lbs.

NILSON OFFERS
5 BIG SAVINGS
IN FORMING WIRE OR RIBBON STOCK

NILSON 4-SLIDES FEATURE —

1 AUTOMATIC OPERATION
From coil to final formed part.
One man can operate 3 or 4 machines.

2 INCREASED PRODUCTION
50 to 400 pieces per minute depending on size.

3 NO SECONDARY HANDLING
Straightening, cutting off, stamping and forming all in one operation.

4 IMPROVED PRODUCTS
Closer control and precision in stamping and forming parts assures uniformity.

5 LOWEST INITIAL COST
Choice of 16 models for efficiency and economy.

Nilson engineers are always available for consultation on forming problems. Bulletin #61 sent on request.

Nilson's 3 tilt reels and 3 stationary models handle wire or ribbon stock coils up to 500 lbs.

A.H. NILSON MACHINE COMPANY

1516 RAILROAD AVENUE, BRIDGEPORT 5, CONN.

Automatic Chain Making Machines • Staple Forming Machines • Wire and Stock Reels • Wire Straightening Equipment • Slide Feeds for Presses • Wire and Ribbon Stock Forming Machines

Flint C. Elder

The passing of **Flint C. Elder** in January, 1956, at the age of 73 is noted with keen regret. At the time of his death he had been residing at 3041 Edgehill Road, Cleveland 18, Ohio.

★ ★ ★

Mr. Elder retired from **The American Steel and Wire Company** in 1947, where he had been a Special Research Engineer. He was born in Paris, Maine, on September 6, 1882, was educated in the public schools of Malden, Mass., and attended the Massachusetts Institute of Technology and the Columbia University School of Mines, from which institution he obtained a degree of Metallurgical Engineer.

★ ★ ★

He entered the employ of the American Steel and Wire Company in 1911 as an assistant in the physical laboratory at the South Works in Worcester. In 1917 he was transferred to Cleveland and made chief of the physical laboratory at the Newburgh Wire Works, where he rendered invaluable service during World War I testing shell steels for ammunition.

★ ★ ★

In 1917 he was transferred to Pittsburgh as a metallurgist and was moved back to Cleveland in 1924 in the same capacity. He was made Chief Metallurgist in 1934 and a month later appointed Director of Research. He was appointed the company's Special Research Engineer in 1942, a position he held at the time of his retirement, after which he carried on as a Consulting Metallurgical Engineer.

★ ★ ★

Mr. Elder had been a member for many years of the American Society for Testing Materials, the American Institute of Mining and Metallurgical Engineers, The American Iron and Steel Institute and The Wire Association, which last he had joined in 1931, later becoming a Director of the society.

★ ★ ★

Mr. Elder was active in Wire Association affairs and in 1943 delivered the Mordica Memorial Lecture entitled "The Wire Drawing Die."

★ ★ ★

Ever alert to progressive developments in the wire industry, to which he contributed substantially, a most thorough student and always ready to extend his broad knowledge to others, he may be recorded as one of the great personalities of our industry.

NOPCO Names New Vice Presidents

Two new Vice Presidents have been elected by the Nopco Chemical Company, Harrison, N. J. They are **Harry A. Batley,** Vice President in charge of industrial production, and **Walter B. Morehouse,** Vice President in charge of industrial sales. The announcement was made by **Ralph Wechsler,** President of Nopco, following a recent meeting of the Board of Directors.

It will pay you
to get samples of
PLYMKRAFT
IMPROVED CABLE FILLER
To keep up to date on cable filler developments, it takes only an inquiry for samples of PlymKraft. This improved type of twisted paper is available in the exact put up that works best on your equipment, with any type of treatment applied—wax, jute saturant, anthracene.
It is made to fine tolerance, always uniform, and backed by the Plymouth Cordage Company, known as the makers of top quality products since 1824.

Write to:

PLYMOUTH CORDAGE COMPANY

Plymouth, Massachusetts

- COPPER - Refined copper produced at primary plants in the United States, 1953-54 (monthly averages) and 1955, by months, in short tons

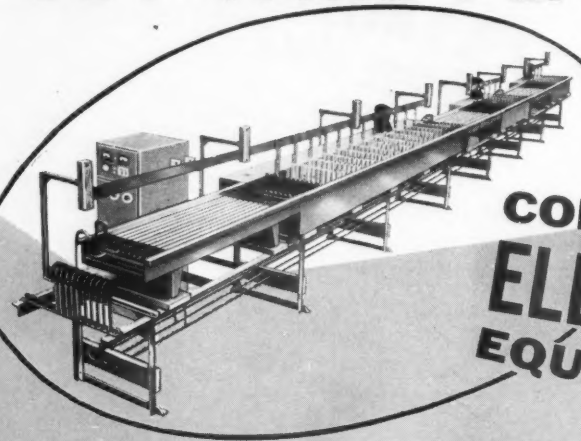
	From primary materials			From scrap		
	Domestic	Foreign	Total	New	Old	Total
1953	77,686	30,074	107,760	9,165	6,634	15,799
1954	70,143	30,850	100,993	8,518	6,477	14,995
1955:						
January	88,312	28,841	117,153	10,123	4,920	15,043
February	81,021	29,994	111,015	8,278	6,295	14,573
March	94,260	26,351	120,611	10.332	7,453	17,785
April	85,118	26,230	111,348	11,076	6,452	17,528
May	96,549	30,575	127,124	11,725	6,034	17,759
June	89,444	28,195	117,639	11,642	7,190	18,832
July	21,294	21,272	42,566	7,412	3,525	10,937
August	55,824	23,081	78,905	8,790	4,633	13,423
September	97,234	32,557	129,791	13,875	6,329	20,204
October	94,218	33,319	127,537	13,448	7,736	21,184

Courtesy of Bureau of Mines

COPPER STATISTICS

CUT WIRE PLATING COST!

maintain uniformity on copper and aluminum wire



CONTINUOUS U.I.E.C. ELECTROPLATING EQUIPMENT

This low cost equipment performs uniform high quality work at speeds that mean real savings. Simple to operate. We furnish complete installation.

Write today to:

UNIVERSAL INDUSTRIAL EQUIPMENT CO.

SECAUCUS, NEW JERSEY

Sole agent in Canada: E. V. LARSON CO., LTD., TORONTO, CANADA

AMERICAN IRON AND STEEL INSTITUTE

350 FIFTH AVENUE, NEW YORK 1, N. Y.

AIS 10

Total Number of Companies Included 133

OCTOBER - 1955
Month

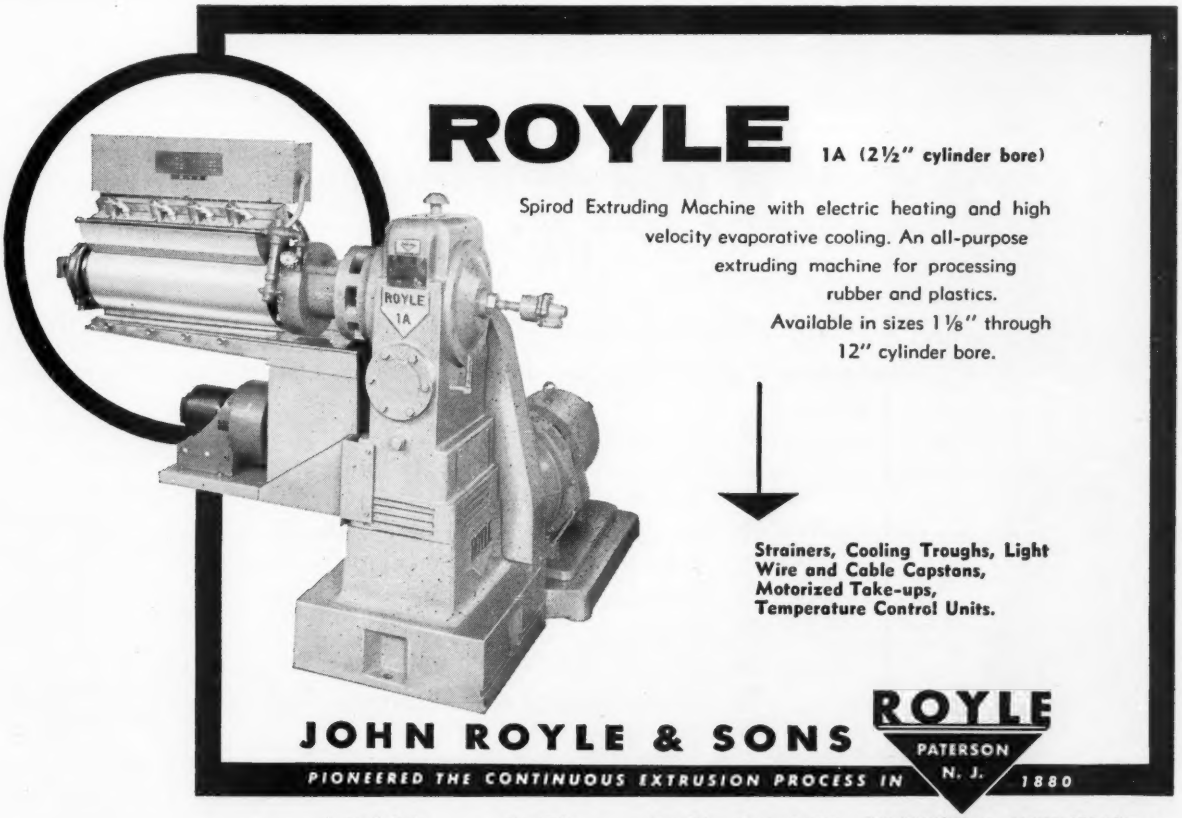
SHIPMENTS OF STEEL PRODUCTS
ALL GRADES INCLUDING CARBON, ALLOY AND STAINLESS
(Net Tons)

Covering Net Shipments (Excluding Shipments to Members of the Industry for Conversion into Further Finished Products or for Resale)

Steel Products	Items	CURRENT MONTH 1955 Carbon	Alloy	Stainless	Total	Percent of Total Shipments	Prior Year (1954) Percent of Total Shipments	YEAR TO DATE 1955 Carbon	Alloy	Stainless	Total	Percent of Total Shipments	Prior Year (1954) Percent of Total Shipments
Ingots	1A	51,579	15,585	2,154	69,318	0.9	0.5	347,019	144,618	21,797	513,434	0.7	0.5
Blooms, slabs, billets, tube rounds, sheet bars, etc.	1B	149,092	54,765	2,803	206,660	2.9	2.3	1,803,218	462,421	17,504	2,283,143	3.3	2.3
Skelp	2	15,884	-	-	15,884	0.2	0.3	147,673	-	-	147,673	0.2	0.2
Wire rods	3	104,652	2,596	812	108,060	1.5	1.5	947,301	19,758	6,923	973,982	1.4	1.2
Total Semi-Finished		321,207	72,946	5,769	399,922	5.5	4.6	3,245,211	626,797	46,224	3,918,232	5.6	4.2
Bars—Hot rolled (incl. light shapes)	14	614,175	194,779	4,646	813,600	11.3	10.5	5,386,934	1,780,914	37,838	7,205,686	10.3	9.7
Bars—Reinforcing	15	202,235	-	-	202,235	2.8	3.0	1,776,550	-	-	1,776,550	2.6	2.8
Bars—Cold finished	16	140,173	25,754	4,811	170,738	2.4	2.0	1,252,340	240,735	44,065	1,537,140	2.2	1.9
Tool steel	17	1,410	8,685	-	10,095	0.1	0.2	12,575	80,562	-	93,137	0.1	0.1
Total Bars and Tool Steel		957,993	229,218	9,457	1,196,668	16.6	15.7	8,428,399	2,102,211	81,903	10,612,513	15.2	14.5
Wire—Drawn	23	277,023	4,402	3,023	284,448	4.0	4.2	2,568,238	38,392	26,422	2,633,052	3.8	3.8
Wire—Nails & staples	24	52,880	-	-	52,880	0.7	1.0	576,113	-	1	576,114	0.8	0.9
Wire—Barbed & twisted	25	4,227	-	-	4,227	0.1	0.1	106,201	-	-	106,201	0.1	0.2
Wire—Woven wire fence	26	17,374	-	-	17,374	0.2	0.3	286,472	-	2	286,474	0.4	0.5
Wire—Bale ties	27	2,340	-	-	2,340	-	0.1	56,002	-	-	56,002	0.1	0.1
Total Wire & Wire Products		353,844	4,402	3,023	361,269	5.0	5.7	3,593,026	38,392	26,425	3,657,843	5.2	5.5
Strip—Hot rolled	37	171,925	4,138	485	176,548	2.4	2.6	1,691,847	26,944	4,413	1,723,204	2.5	2.2
Strip—Cold rolled	38	132,922	1,566	24,209	158,697	2.2	2.2	1,176,936	12,280	220,690	1,409,906	2.0	2.0
Total Sheets and Strip		2,638,049	108,463	40,419	2,786,931	38.6	37.2	25,215,817	933,083	373,075	26,521,975	37.9	33.0
Total Shipments (1955)		6,631,174	522,899	62,748	7,216,821	100.0	xxx	64,755,178	4,570,740	563,506	69,889,424	100.0	xxx
Total — Prior Year (1954)		4,674,823	319,795	40,746	5,035,364	xxx	100.0	49,121,636	3,000,587	362,799	52,485,022	xxx	100.0

*Revised.

STEEL STATISTICS


ROYLE
1A (2½" cylinder bore)
Spirod Extruding Machine with electric heating and high velocity evaporative cooling. An all-purpose extruding machine for processing rubber and plastics.
Available in sizes 1⅛" through 12" cylinder bore.
ROYLE 1A
Strainers, Cooling Troughs, Light Wire and Cable Capstans, Motorized Take-ups, Temperature Control Units.
JOHN ROYLE & SONS
ROYLE PATERSON N. J. 1880
PIONEERED THE CONTINUOUS EXTRUSION PROCESS IN
London, England James Day (Machinery) Ltd. Hyde Park 2430 - 0456
Home Office V. M. Hovey J. W. VanRiper SHerwood 2-8262
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Los Angeles, Cal. H. M. Royal, Inc. LOgan 3261
PATERSON 3, NEW JERSEY

ALUMINUM STATISTICS
(in pounds)
Collected by The Aluminum Association for October 1955

	October 1955	September 1955	October 1954	1st 10 Months 1955	1st 10 Months 1954
PRIMARY PRODUCTION	269,312,211	261,211,002	250,178,989	2,582,695,203	2,424,557,637
SHIPMENTS OF ALUMINUM PRODUCTS					
SHEET and PLATE.....Total	125,029,168	120,717,368 *	88,939,681	1,166,728,084	836,706,838
Non Heat-treatable	98,670,156	95,487,885	71,611,046	928,580,450	648,404,185
Heat-treatable	26,359,012	25,229,483 *	17,328,635	238,147,634	188,302,653
FOIL (including foil in lamination, aluminum content only)	18,066,419	18,376,581	14,809,227	168,492,548	121,682,333
EXTRUDED PRODUCTS.....Total	38,712,867	33,711,042	26,185,915	340,575,728	227,607,883
Alloys 1100-3003-5052-6061-6062-6063	34,162,483	31,168,425	22,037,334	304,888,761	176,007,289
All other alloys	4,550,384	2,542,617	4,148,581	35,686,967	51,600,594
TUBE, Drawn.....Total	4,614,023	4,263,911	3,990,777	62,746,445	48,681,511
Alloys 1100-3003-5052-6061-6062-6063	3,966,826	3,566,076	3,620,845	56,958,346	42,009,751
All other alloys	647,197	697,835	369,932	5,788,099	6,671,760
BAR and ROD, Rolled (3/8" and over, maximum diameter across flats)	15,990,161	15,036,454	11,470,346	149,363,435	118,261,227
WIRE other than Conductor	5,203,577	4,281,775	3,571,017	40,789,507	30,576,703
ACSR and CABLE, Bare	8,891,070	10,003,930	6,958,262	101,725,972	95,201,044
FORGINGS	3,277,306	4,103,694	3,828,036	38,114,830	37,303,730
CASTINGS (incl. pistons, cookware)...Total	15,731,447	14,990,563	13,038,873 ‖	156,574,552 ‖	123,432,041 ‖
Sand	1,433,957	1,547,743	1,769,888	16,194,951	17,724,513
Permanent Mold	14,297,490	13,442,820	11,268,985	140,379,601	105,707,528
Total number of companies included	45	44	43 *		

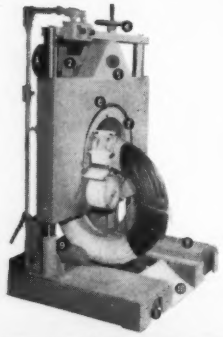
December 2, 1955

* Revised from previous reports.

‖ No longer includes die casting shipments.

1 man can operate Angier's NEW UW-10 spiral wrapper . . .

These features make it the most versatile machine available



1. Automatic electric brake.
2. Direct connected high starting torque motor.
3. Shuttle jog control.
4. Vertical shuttle adjustment. (Power drive available)
5. V-Belt shuttle drive (concealed).
6. Ball-bearing shuttle rolls.
7. Forged steel shuttle.
8. Separate motor for feed roll drive (concealed).
9. Horizontal feed roll adjustment (both rolls).
10. Roll-in loading.

Angier Corporation, Framingham 3, Mass.

Angier

GET FACTS ON THE UW-10 AND OUR FULL LINE OF SPIRAL AND BAR PAPER WRAPS.

A Review of Recent Wire Patents

No. 2,725,713, CABLE CONSTRUCTION, patented December 6, 1955 by Andre Blanchard, Houston, Tex., assignor to Schlumberger Well Surveying Corporation, Houston, Tex., a corporation of Delaware.

A cable is disclosed adapted for use in a bore hole or the like and comprises a tapered load carrying portion, and a coating on the outside of the cable having a thickness which is a maximum at the one end of the cable at which the load carrying portion has the least cross-sectional area and is progressively less at different locations between the two ends of the cable in inverse relation to the distance from this one end.

★ ★ ★

No. 2,726,817, WINDING MACHINE, patented December 13, 1955 by John Barrows, Brookline, Mass.

The machine is adapted for winding toroidal coils and segments thereof, and includes a support divisible into two parts, with a wire-carrying shuttle, also divisible, guiding rollers for the shuttle and carried by each part and by the shuttle, and a core-rotating mechanism. There are seventeen claims.

★ ★ ★

No. 2,726,818, WINDING MACHINE, patented December 13, 1955 by Walter Bailey, Silver Spring, Md., assignor of one-third to Edward A. Camp and one-third to Henry J. Dorr, Washington, D. C.

Manually settable means is provided, and in conjunction therewith, indicating means to variably predetermine the number of revolutions to be made by a power-driven shaft before it is disconnected from the source of power.

★ ★ ★

No. 2,726,819, WINDING METHOD AND MACHINE, patented December 13, 1955 by Waldo H. Zander, Brookville, Fred D. Zander, Dayton, and Delbert I. Wilson, Tipp City, Ohio, assignors to McGraw Electric Company, Elgin, Ill., a corporation of Delaware.

The invention relates to wire heating coils of the flat type having straight windings all located on one face of a flat form. There are forty-seven claims to the method or machine and forty-two drawings to illustrate.

★ ★ ★

No. 2,726,820, WINDING MACHINE, patented December 13, 1955 by Delbert I. Wilson, Tipp City, Ohio, assignor to McGraw Electric Company, Elgin, Ill., a corporation of Delaware.

This patent is for a flat-core winding machine and related to patent No. 2,726,819.

★ ★ ★

No. 2,726,821, APPARATUS FOR DEPOSITING SPECIALLY SHAPED CONVOLUTIONS OF A CONTINUOUS ARTICLE ON ROLLS, patented December 13, 1955 by Robert S. Enabnit, Cuyahoga Falls, Ohio, assignor, by mesne assignments, to The Goodyear Tire & Rubber Company, a corporation of Ohio.

Reinforcing wires for reinforcing air bags for use in high electrical frequency vulcanization of rubber articles are automatically wound by this apparatus.

★ ★ ★

No. 2,726,971, APPARATUS FOR DRYING AND ANNEALING WIRE, patented December 13, 1955 by Joseph V. O'Grady, West Caldwell, N. J., assignor to Syncro Machine Company, Perth Amboy, N. J., a corporation of New Jersey.

The wire is preheated in a zone before it reaches the annealing chamber, heated to annealing temperature while in the chamber and dried in a zone after it leaves the chamber, employing electric circuit connections to separately heat the several zones.

★ ★ ★

No. 2,727,087, ARMORED OIL WELL CABLE, patented December 13, 1955 by Clifford O. Hull, Stratford, Conn., assignor to General Electric Company, a corporation of New York.

An electrical cable is provided with an open braided glass yarn covering surrounding a vulcanized thermosetting elastomer sheath for the wire conductor, and a flexible interlocking metallic armored tape surrounding the covering and interlocked therewith by spaced-apart portions of the sheath extending

Sheffield's **KONE-PAK** (patent applied for) is a stout cone-shaped steel frame on which we spool the wire. The whole deal is mounted on a disposable wooden pallet. Packaged in a super-strength cardboard container if desired.

Sheffield Wire in New KONE-PAK can cut your production costs 3 ways!

SHEFFIELD
ARMCO
Manufacturers' Wire

You know your costs on unloading a car containing 100 to 2000 coils of wire. Compare that to picking up and moving 50 compact KONE-PAKS on a pallet handling truck.

Here's other ways you save with KONE-PAKS: (1) Fewer units stored in more compact space; (2) faster set-up for threading into machines; (3) bigger "feedings" for machines; fewer loadings and less dead time.

Of course the best packaging plays second fiddle to what's inside. In this case it's the best wire of its kind—quality-controlled every step of the way from Sheffield furnaces to finished product. Watch your production costs shrink with Sheffield Wire—now with the big plus of KONE-PAKaging.

Products of
SHEFFIELD STEEL
DIVISION
ARMCO STEEL CORPORATION
SHEFFIELD PLANTS: HOUSTON • KANSAS CITY • TULSA

between some of the yarn into a spiral groove of the armor.

★ ★ ★

No. 2,727,255, METHOD OF AND APPARATUS FOR FORMING AND THREADING THE POINTS OF WOOD SCREWS AND THE LIKE, patented December 20, 1955 by Victor Hill Fray, Auckland, New Zealand.

The apparatus comprises a planetary type thread rolling apparatus having a thread roller and a stationary threaded segment, a hob having an angular forming or cutting face at an angle complementary to the angle to be formed on the point of the screw and disposed directly against the thread roller eccentrically in relation to the latter, at least one helix on the cutting face complementary to the thread to be formed on the point of the screw, the hob being driven faster than and oppositely to the thread roller.

★ ★ ★

No. 2,727,541, WIRE TWISTING APPARATUS, patented December 20, 1955 by Jack W. Preston, Van Nuys, Calif., assignor, by mesne assignments, to Hughes Aircraft Company, a corporation of Delaware.

An assembly is provided for forcibly rolling axially adjacent portions of predetermined length of wire at different angular velocities over a friction surface when the predetermined length of wire is placed between two friction surfaces of two machine members; and means for driving one member such that the adjacent transverse portions of the surface of the other member move at different linear velocities with respect to each other and with respect to the first surface.

★ ★ ★

No. 2,727,698, TOROIDAL COIL WINDING MACHINE, patented December 20, 1955 by Clarence C. Stevens, Forestville, Conn., assignor, by mesne assignments, to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

This is a shuttle and rollers type winding machine, together with a belt for a pair of the rollers for engaging portions of the periphery of a core to be wound.

★ ★ ★

No. 2,727,703, INSERT FOR CORELESS ROLL OR WIRE, patented December 20, 1955 by Robert N. Bonnett, Wellesley Hills, Mass., assignor to the United States of America as represented by the Secretary of the Army.

A cylindrical fabric housing is provided for encasing the roll of wire and comprises flat wall sides each having a center opening, a rubber grommet secured to each wall and encircling said opening therein, a removable core member having a cylindrical portion of equal diameter as the openings, and of sufficient length to extend at least between the opening, this portion being provided with a longitudinal slit therein to provide a flexible surface at the extremity only of the core, and a planiform relatively rigid flange portion affixed at one end of the cylindrical portion whereby insertion of the core member in the openings, with a flange portion in external contact with the housing permits wire to be paid out between the periphery of the core and the adjacent edge of the rubber grommet.

★ ★ ★

No. 2,728.278, COILED MUSICAL INSTRUMENT STRING AND MUSICAL INSTRUMENT STRUNG WITH SAID STRING, patented December 27, 1955 by Joseph F. Dvorak, Cincinnati, Ohio, assignor of one-half to Joseph Litochleb.

The string, of wire, has a speaking length consisting of the string in the form of a cylindrical coil having an inside diameter not greater than the diameter of the string and an outside diameter not greater than .6% of the stretch of the coil in tuned position.

★ ★ ★

No. 2,728,358, METHOD OF WEAVING WIRE CLOTH, patented December 27, 1955 by William A. Kools, Neenah, Wis.

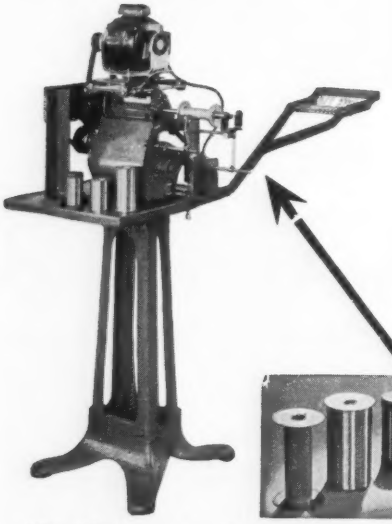
In the weaving of twill wire cloth with a number of interspersed sets of warp wires each set of which is successively separated from the other sets to form a shed for the insertion of a shute wire, the improvement disclosed comprises maintaining a greater tension in one of the other sets of warp wires than in the remainder of the other sets during the beat-up of the shute wire, this one set being the set which occupied the separated position for the insertion of the previous shute wire.

★ ★ ★

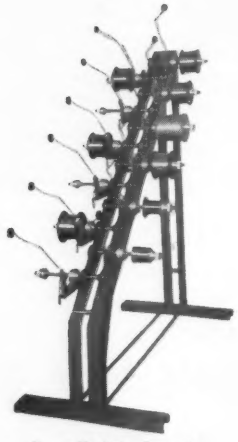
No. 2,728,477, WIRE DRAWER, patented December 27, 1955 by Ben F. Ware, Euclid, Ohio, assignor to The

STANDARD UNI-DRIVE WIRE WINDER.

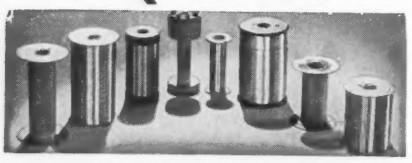
INCREASE YOUR PRODUCTION
WITH THIS WINDER



Wire Winder



Pay-off Attachment



Various types of supply packages that may be wound on Standard Uni-Drive Wire Winder.

PAYOFF

Our payoff attachment is made with self-aligning ball bearings and a compensating attachment to control the tension of each end. Applies same tension when spool is empty as when full.

The new Uni-Drive Winder with Payoff Attachment is new in design and incorporates several improved and tested features. Production is stepped up through increased speed. It produces smooth, even and accurately wound spools of wire in single or multiple ends. All strands parallel—no over or under-winding. Automatic Stop-Motion controls each strand. Compensating attachment produces perfectly controlled tension. Traverse adjustable from 1¾" to 5¼" between spool heads without changing cam. Designed especially for winding wire to be braided and shielded for electrical conductors up to ¾" diameter.

Payoff can be equipped with Carboloy Guide Inserts at additional cost.

STANDARD MILL SUPPLY COMPANY
PAWTUCKET, RHODE ISLAND, U.S.A.
1064-1080 Main St.
PAwtucket 3-1534 — 3-1535 — 3-1536

Ajax Manufacturing Company, Cleveland, Ohio, a corporation of Ohio.

More specifically, the invention resides in a grip mechanism for the drawer. There are seven claims.

★ ★ ★

No. 2,728,448, MULTIPLE-ORIFICE WIRE DRAWING DIE, patented December 27, 1955 by Ben F. Ware, Euclid, Ohio, assignor to The Ajax Manufacturing Company, Euclid, Ohio, a corporation of Ohio.

The holder is provided with a pocket of specific shape, being defined by a pair of symmetrically disposed intersecting recesses of a circular-segment shape having curved side walls of at least 180 degrees arcuate extent, with a pair of die members seated in the recesses and having individual drawing orifices extending therethrough such that the orifices are spaced inwardly from the peripheral edges of the die members.

★ ★ ★

No. 2,728,504, COLLAPSIBLE PORTABLE CARRIER FOR HANDLING STACKED ARTICLES, ESPECIALLY CONTAINERS FOR BAKERY PRODUCTS, patented December 27, 1955 by Wilbur C. Vaughn, Berwick, Pa.

This carrier comprises a collapsible framework in the form of a hollow parallelepipedon and is constructed wholly of stout wire.

No. 2,728,358, METHOD OF WEAVING TWILL FOURDRINIER WIRE CLOTH, patented Dec. 27, 1955, by William A. Kools, 143 Fifth St., Neenah, Wis., for an improvement by regulation of the relative tensions of the lower warp wires to avoid an unsymmetrical sloping long crimp that is deeper at one end than the other. There are 10 claims of originality.

★ ★ ★

New Reel Construction Announced

The Hubbard Spool Company has announced a new reel made of steel reinforced water-resistant plywood for shop, general process and returnable shipping reels. The construction embodies greater impact strength to withstand abuse. If dropped, the flanges will absorb the impact without bending and taking a permanent set, as would be the case with the conventional type steel reel commonly used.

★ ★ ★

These reels can also be submerged in water for a limited time for the testing of cable, reducing the possibility of rusting to a minimum. They are also lighter in weight, which makes for easier handling and lower shipping charges.

★ ★ ★

In most instances the reels have a lower initial cost, plus lower maintenance costs due to having no need for flange straightening. The one-piece galvanized flanged steel barrel used makes for easy assembly or repairs, if needed.

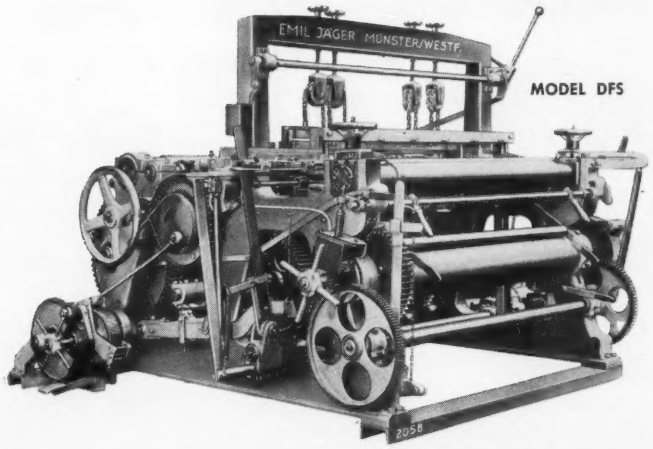
★ ★ ★

This new construction is available in a large range of sizes and flange thicknesses, with a variety of reinforcement features to meet different operating conditions. For more detailed information, please write or telephone Hubbard Spool Company, Garrett, Indiana.

JAEGER . . .
Automatic Wire Weaving LOOMS

Weaving range of MODEL DFS is 1-120 meshes per inch, with Special Regulator for up to 300 meshes.

Wire sizes: .032" and finer. Loom adjustable for single blow, light double and heavy double blow.



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We have a complete line of looms from the coarsest mesh up to 450 mesh per inch.

For further information write us giving details.

CEDAR WEST TOOL COMPANY, INC.

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Chemical Wire Stripper

A new product, Chemclean #493, has been developed by **Chemclean Products Corp.**, 610 Warren St., Brooklyn 17, N. Y., for consumers of insulated wire. Chemclean #493 is an economical stripper, simple in operation, non-flammable, which chemically removes Formvar, Formex, Isonel and baked enamel coatings from wire; eliminating mechanical breakage and distortion. The material is formulated so that wire dipped into the Chemclean #493 is uniformly coated with the stripper. The bond between the insulation and the wire is broken and the insulation is wiped off, leaving the wire ready for soldering or other processing. Chemclean #493 will also remove various other organic finishes and may be used on vertical and overhead surfaces.

Bulletin on Molybdenum Disulfide

Bulletin 103A, a four-page, two-color catalog of the variety of **Molykote** Lubricants now available to industry, has been published by **The Alpha Molykote Corporation,** 65 Harvard Ave., Stamford, Conn.

* * *

The bulletin, an up-to-date revision, lists seventeen types of this molybdenum disulfide lubricant line and features a complete explanation, with diagrams, of the importance of this compound in extreme bearing pressure, and high, low and normal temperature lubrication applications. Five new **Molykote** lubricants are included.

* * *

The highlight of the bulletin is a selector chart which describes each MoS2 type, the kind of carrier used in it, the temperature range in which it operates best, and the proper method of application.

* * *

Copies are available upon request to the company.

New VS Drive Announced

Reliance Electric & Engineering Co., 1088 Ivanhoe Rd., Cleveland 10, Ohio, has announced the new Reliance VS-100 Drive, a low cost tension regulating drive for center winding a wide variety of materials without any physical tie-in between the main machine and the winding section. Paper, polyethylene, nylon, glass, wire and many other products have been successfully wound in production installations.

* * *

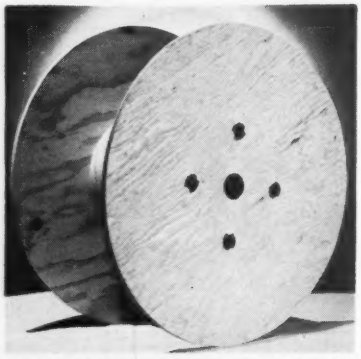
The VS-100 Drives have a capacity at constant tension from 1/8 to 2 horsepower with the exact limits being a function of line speed range, build-up and tension. For special winding requirements, on applications such as inspection tables, the drive can be modified to provide extremely close speed

HUBBARD Can Supply You with All Types of

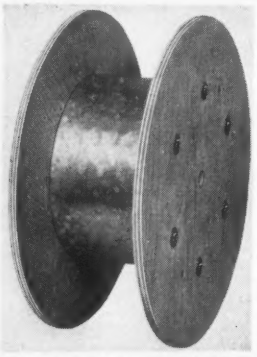
NON-RETURNABLE SPOOLS and REELS for

WIRE • ROPE • TAPE • BRAID • PLASTIC EXTRUSIONS

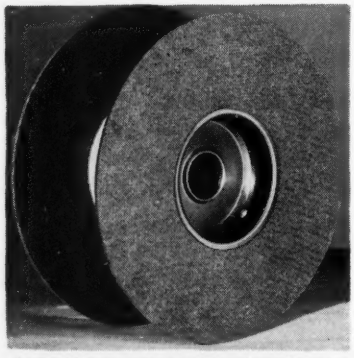
Pictured below are a few of these types



Reel with plywood flange with cardboard hub assembled with tubular rivets for non-returnable and export shipments.



Reel with plywood flange and galvanized steel hub assembled with tubular rivets and special washers for heavier loads.



Reel with masonite flange and cardboard hub assembled with steel end washers for domestic or export shipment of wire, tape, braid or other materials.

Reels and Spools supplied in all types and combinations of constructions.

HUBBARD SPOOL COMPANY

GARRETT (Tel.: Garrett 840) INDIANA

regulation (by tachometer feedback). The addition of an amplifying section on a "building block" basis converts the basic panel into a precision regulator. Standard single-phase power is required.

Largest Single Conductor Cable

Two reels of what is believed to be the largest single-conductor cable of its type ever made—wire size: 2,000,000 circular mills, about 2 inches in diameter—are being shipped from the **Continental Wire Corporation** plant at 560 Maryland Ave., York, Pa., to the General Motors Corporation in Michigan. Each 500-foot reel weighs over a ton and a half. By way of contrast, Continental Wire also insulates wire drawn nearly as fine as a human hair—0.003 inches in diameter.

★ ★ ★

Cable of the 2,000,000 cm size is able to carry extremely heavy currents—up to 1,715 amperes. The stranded copper conductor is covered with multiple layers of asbestos and varnished cambric insulating tapes and an outer cover of asbestos yarn braid. This construction renders the big cable resistant to high temperatures as well as to oil, grease, corrosive vapors and moisture.

Comment and Reply on Convention Paper

Benoit J. Sirois, Chairman of the Non-Ferrous Program Committee for the 1955 Annual Convention of The Wire Association, received the following written comment on the paper "Accelerated Heat Aging of Polyethylene", written by W. W. Spohn and S. P. Foster of the Development and Service Section, E. I. du Pont de Nemours & Co., Wilmington, Del.:

"The paper by Messrs. Spohn and Foster was particularly interesting. On Page 6 of this paper the statement is made that Polyethylene can be degraded at extrusion temperatures. It would be very desirable for the authors to expand a little more on this as degradation can result from too low as well as too high a temperature, and aside from any effect of heat, other conditions of extrusion such as die shape and speed also have some effect. These effects are not oxidative but purely due to residual stresses which can only be relieved by heat at temperatures approaching extrusion temperatures.

It is a pleasure to know that these effects are being studied and it is hoped that test procedures will be developed which are better suited to the evaluation of the properties of Polyethylene and other plastics than those in current use."

★ ★ ★

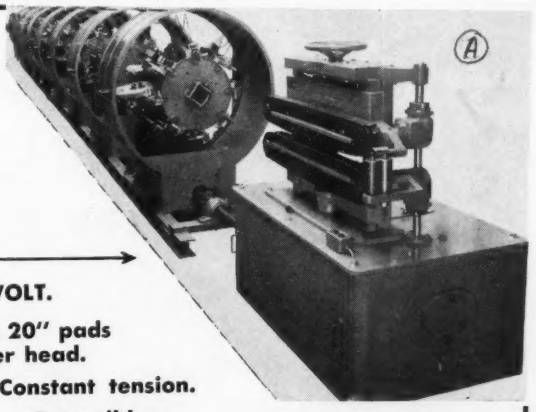
To this letter Mr. Spohn replied:

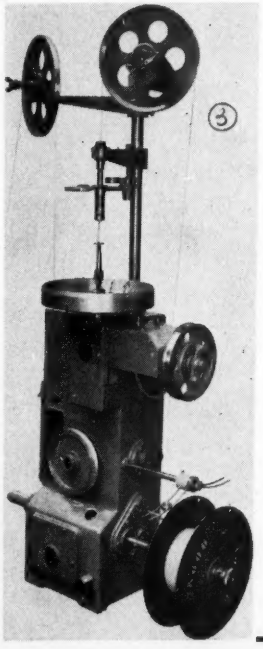
"The question has to do with the possible degradation and/or exchanges in polyethylene's physical and chemical structure which can be brought about at extrusion temperatures. This problem is a very complicated one, as you can very well appreciate. Mr. W. Hooper, of our Sales Service Laboratory, had hoped to present a paper at the Signal Corps Symposium this year based on this very subject. However, the problem has become so involved and complicated, more time will be required for extrusion, testing, etc. Mr. Hooper plans to present such a paper next year if at all possible."

Join the WIRE ASSOCIATION and work with others to improve the industry. Send for booklet.

NEW...

IN PAPER LAPPING





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— 8 x 20" pads per head.
— Constant tension.
— Extensible pad centre.
— Individually braked.
— Variable die.
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— P.I.V. drive.
— Automatic stop.

POURTIER MACHINES
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ROMAINVILLE (Seine) FRANCE

Wire Rope for the Steel Industry

(*Continued from page* 198)

This operation is accomplished by means of cradle hoist and counterweight ropes. At this point the cradle is rotated and the entire contents of the car is dumped into the pan which is operated by the pan hoist rope. The pan is connected to a chute which leads directly to the hold of the barge or ship. The ropes on these machines run from 5/8" to 1-3/4" diameter, usually of 6 x 25 construction, preformed, Lang lay, with fiber core.

★ ★ ★

Limestone used in the manufacture of iron and steel, is taken from the quarries by a variety of machines. Wire rope is used on the excavating machines, the inclines and derricks. These ropes are usually 6 x 19 and 6 x 25 construction, preformed, with both fiber core and IWRC. Guys for the derricks are usually 7-wire galvanized strand or 6 x 7 galvanized rope.

★ ★ ★

We have now reached a point where the coal, iron ore and limestone are ready to be processed in the making of iron and steel. The coal, however, after arriving at the Steel Plant, must be converted into coke before delivery to the blast furnace. This is done in coke ovens which employ leveler bar ropes. These are usually 6 x 37 preformed with IWRC.

★ ★ ★

The coke, iron ore and limestone are now sent to the blast furnace where they are conveyed and dumped by means of an inclined skip hoist. Operating ropes on these hoists range from ¾" to 1⅜" diameters 6 x 25 Lang lay, preformed, fiber core. The large and small bells which cover the top of the blast furnace are raised and lowered by means of wire rope ranging from 1-1/4" to 1-3/4" 6 x 25 Lang lay, preformed, fiber core. After the blast furnace has yielded its charge of iron, we are now prepared to proceed to the making of steel in the open hearth steel mill.

Open hearth furnaces are charged with the above iron, steel scrap, limestone and other ingredients in the making of steel. At the proper time the furnace is tapped and the contents poured into a ladle located on the pouring floor. These **ladles** are handled by overhead traveling cranes on which wire rope is reeved in multiple parts and varying in diameter from ¾" to 1⅜" 6 x 37 preformed, IWRC. These cranes are also equipped with an auxiliary hoist of smaller capacity, which is used for tilting the ladle and various other operations on the pouring floor.

★ ★ ★

We might point out here that possibly the most widespread use of wire rope in steel mills is confined to traveling cranes. Where the ropes on these cranes are exposed to any appreciable heat, an IWRC is recommended rather than a fiber core which would be subjected to deterioration and thereby lose its value as a supporting member for the outer strands of the rope.

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Soaking pit cranes which are used to transport the ingots to the blooming mill also use wire rope, both on the main hoist and tong hoist. The latter actuates the tong clamps as the ingot is hoisted from the soaking pit.

★ ★ ★

We might also include wire rope slings which would be used for handling rolling mill rolls, billets, slabs and various other materials. Without these slings, safe and economical operation would hardly be possible.

★ ★ ★

It is well to remember in the maintenance of wire rope and equipment using wire rope, that this wire rope is a machine, and lubrication usually helps machines; definitely it helps wire rope. It is also well to remember that wire rope needs freedom in which to operate and the sheaves should be kept satisfactorily so that wire rope is not unduly pinched during operation.

★ ★ ★

One of the pertinent things about wire rope which is many times overlooked, is that wire rope is expendable. This is especially and particularly true of operating wire ropes where long life is not necessarily a requirement but rather lower first-cost in the construction of the machine and speed of operation are far more important than making sure that the wire rope will last an extra week or month or so. Also, the degree of safety of operation necessary will vary the length of life of the wire rope. Too many times we have regarded wire rope as a permanent member of the machine and we have not used it in certain design work where it definitely would be lighter, easier to handle and no doubt result in a less first-cost.

★ ★ ★

This idea of increasing the production by wearing out wire rope a little faster is not new; in fact it has been going on in all industry ever since before the original Taylor System was introduced into manufacturing plants. As I recall, this efficiency system which was so troublesome to the old-timers of that day, started in a short time after the turn of the century. Also, it is necessary to add that wire rope was not the only material that was used up faster. With all this, our costs have been reduced and more material has been made available to lots more people. For our own good and protection we must keep this same practice alive.

★ ★ ★

Many individual operations in use today could be checked to see whether or not the overall economy would be improved by using up wire rope at a somewhat faster pace.

★ ★ ★

During this time, speaking about wire rope in particular, the improvements in wire and rope making processes and refinements of construction have so improved, that in many cases, despite of the increased use of the material, the wire ropes are actually lasting longer. This again seems like a paradox, but in many cases it is

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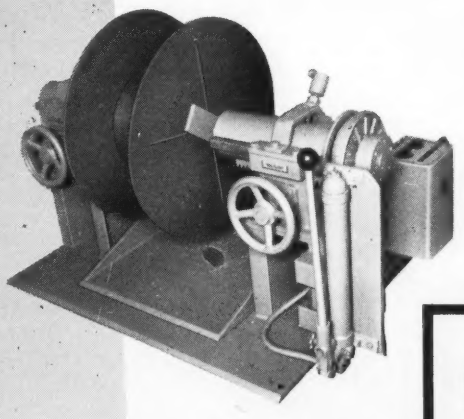
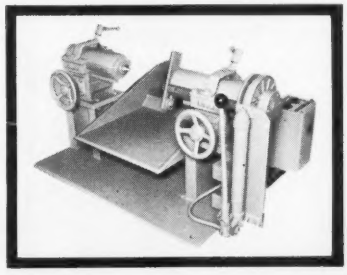
New, modern—the WIM Model A Shaftless Payoff Stand—offers smooth, easy and continuous tension control; simple hydraulic lift loading; and faster action.

The unit will handle any spool size from 16" to 36" and up to 1000 lbs. total weight. Trouble-free operation is assured by ball bearing mounted spool arbors.

Think of WIM for the finest wire handling machinery.





WIM Model A Shaftless Payoff Stand
Write for complete details.

WIRE INSULATING MACHINERY INC.
DIVISION: MACHINERY ELECTRIFICATION, INC.
NORTHBORO, MASS. 35 HUDSON STREET

true. The reason for it has been that the competition in wire rope has been so keen that improvements have been made and put into operation and new research immediately started on further improvements. This is still the practice and we fully expect improvements in wire rope to continue.

★ ★ ★

It is this development that has made it economical to use wire rope on smaller and more heavily loaded equipment. Wire rope is still one of the safest structural members. Suitable and proper inspection practice can keep this true.

★ ★ ★

Some day a replacement may be invented for wire rope, just the same as when wire rope came into wider and wider use it replaced a number of other materials. Just what this may be is rather hard to visualize. However, until that time comes, wire rope will continue to be the very same, economical, flexible, versatile and safe mover of materials that it always has been.

Thread Obtained with New PIP Insert

With the development of the new PIP push insert, by the **Heli-Coil Corp.,** Danbury, Conn., it is no longer necessary to tap internal threads in a hole to receive a threaded screw or bolt. The PIP push insert is pushed into a straight-sided, plain hole to provide strong, wear resistant female threads in non-structural parts at a cost of less than one cent per hole. The hole can be drilled, molded or die cast.

★ ★ ★

The PIP push insert is recommended for the entire family of plastics; zinc die castings; permanent mold and sand casting alloys; wrought, die cast and cast aluminum alloys; lead base casting alloys; soft copper base alloys; and ferrous metals under certain conditions. Like the standard wire thread insert from which it has evolved, the PIP insert is manufactured from wire coiled into a helix.

★ ★ ★

The PIP push insert is available as standard in copper-clad steel but is also available in phosphor bronze, cadmium-plated steel, Nuglid—any material which can be formed into wire.

To Manage Mill Division for Scovill

On January 1st **Chauncey P. Gross,** Vice President of **Scovill Manufacturing Co.,** Waterbury 20, Conn., became manager of the company's Mill Division.

★ ★ ★

At the same time **Arthur P. Hickox,** Vice President and General Manager, also announced the appointment of **Paul E. Fenton** as manager of the Button and Fastener Div. and **Henry W. Wild** as manager of the General Manufacturing Div. Both the latter are also vice presidents.

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Wire Fabricators

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EXTRA FLEXIBLE CONDUCTOR STRANDED OR BRAIDED

MULTIPLE ENDS OF SIZES .008 to .002

BARE • TIN or LEAD COATED • SILVER PLATED

Special Heavy Tinned Conductors for Hook-up Wire

40 MASONIC AVENUE • CAMDEN, NEW YORK

Colloidal Graphite As A Wire Drawing Lubricant

(*Continued from page* 185)

Basically these lubricants are of two types: those susceptible to heat and those resistant to heat. All substances are altered by thermal conditions, and most lubricants are greatly affected within the heat ranges involved in wire-drawing operations. Oils or greases thin out as temperatures rise; this, alone, changes their lubricating value considerably. At some critical temperature, organic boundary-lubricant films volatilize or decompose, resulting in greatly reduced lubricity. This point is reached when the drawing load increases sharply. In the case of lubricants consisting of a mixture of substances, each with its own temperature of volatilization or decomposition, drawing load ordinarily will increase in a series of steps.

★ ★ ★

Fig. 5. Three-stand, high-speed, flat wire rolling mill operates at speeds up to 2000′ per minute, producing 1000 pound reels of finished wire, compared with a previous maximum of 250 pounds. * * * * *

Fig. 6. Schumag draw benches. Continuous operation: drawing, cutting to length, straightening and polishing. Improved product, straighter than before and having a better surface. Machine takes 158 to 590 round rod only, and does four operations in one. * * * * * * *

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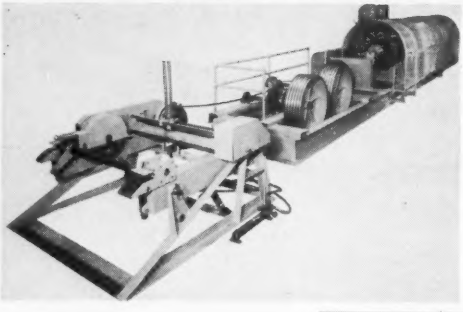
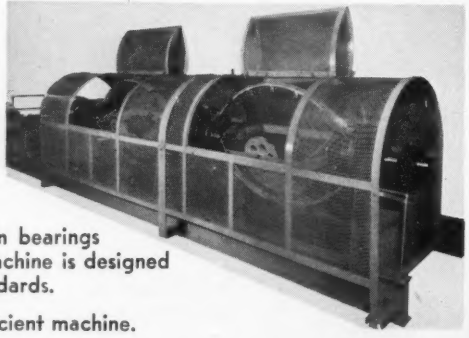
THREE-WIRE HEAVY DUTY TWISTING MACHINE



Built to handle wire from #14 to 500,000 circular mils in size on cradle reels.

Cradle reels either 30", 36" or 48" in diameter.

Rotor speeds from 800 r.p.m. to 30 r.p.m. controlled by gear box and dual drive.



Capstans either single with fleeter sheave or double as shown with diameters of 30", 36" or 42". Rates of lay from 1½" to 36".

Welded steel frame, anti-friction bearings and multiple roll guides. The machine is designed and built to our usual high standards.

An exceedingly versatile and efficient machine.

THE EDMANDS CO., 228 ABORN STREET PROVIDENCE 3, R. I.

Graphite, however, is to all practical purposes inert under conditions met in drawing practice. When graphite dispersions are used in cold-drawing, the liquid carrier may evaporate at the die face. In hot-drawing, the carrier is always driven off well before the wire reaches the die. In either case, the graphite coating alone provides the necessary lubrication. Whenever graphite dispersions are used, the liquid vehicle need serve only to distribute the solid lubricant effectively on the wire surface, and the graphoid film produced by high surface pressure in the die provides lubrication for the draw. In some cases lubrication actually gets better as temperatures are raised. Further tests, run with silicone lubricants, demonstrated these advantages of 'dag' dispersions most dramatically (Fig. 3). A commercially available silicone fluid, DC710, gave adequate lubrication up to its flash point (approximately 610°F.); beyond this, drawing was impossible. On the other hand, a companion product (silicone fluid DC710G), differing only in that it contains 5% 'dag' semi-colloidal graphite, permitted drawing at temperatures above 850°F. It can be seen, too, how the drawing load, between 400°F. and 700°F. with the graphited silicone, is consistently below that recorded at lower temperatures.

★ ★ ★

Chemically deposited copper coatings on steel wire are very satisfactory when drawn wet. In testing dry-drawing of such coatings, they were found to peel off, and above 300°F. they oxidize and score the dies. However, when copper is deposited electrolytically on a colloidal graphite undercoating, promising results are obtained—further work along this line may be undertaken later on.

★ ★ ★

Another prime industrial need today is for copper and copper-base alloy wires. The continually growing market has put severe demands upon wire manufacturers to increase production quickly and economically. The best way to do this is to increase drawing speeds on existing equipment. Work in this direction has led several prom-

inent manufacturers to test exhaustively the effectiveness of adding colloidal graphite to their drawing compounds. Results have been so favorable that graphited lubricants are now standard in many plants.

★ ★ ★

One typical case is that of a company producing a variety of brass and bronze wires. Here, a low-brass wire was to be drawn to one-ninth of its original cross-sectional area—from 0.092-inch diameter to 0.032-inch. The wiredrawing equipment employed in this operation used eight dies per machine and a speed of 2,000 feet per minute was desired. The first of the eight dies in the series reduced wire diameter from 0.092 inch to 0.085 inch and wore very rapidly. Only three spools, of 300 pounds each, could be drawn before breakage occurred. This die showed consistent "ringing" or excessive wear at initial point of pressure.

★ ★ ★

It was recommended that 2%, by weight, of 'Aquadag' be used in undiluted soluble soap. A special box was made to contain this paste lubricant and the wire was drawn through the mixture before entering the first die. Immediately die life was increased ten-fold, permitting uninterrupted drawing of at least 30 spools. Continued high production of this wire has verified these results and has definitely proven them to be due entirely to the incorporation of 'Aquadag' as described above.

★ ★ ★

As a result of the success on this job, it was decided to standardize on 'dag' Colloidal Graphite for all the drawing machines in the plant. To accomplish this, an initial charge of 24 pounds of 'Aquadag' was added to the central reservoir, which contains 2,000 gallons of soluble soap solution. This formulation (a 0.15% dilution of 'Aquadag') has been in use ever since for drawing all types of wire produced at the plant—bright annealed alloys of brass, bronze and nickel. Reductions down to 0.028-inch diameter are made at speeds of 800 feet per minute to 2,000

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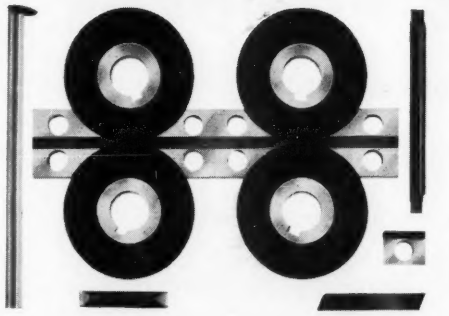

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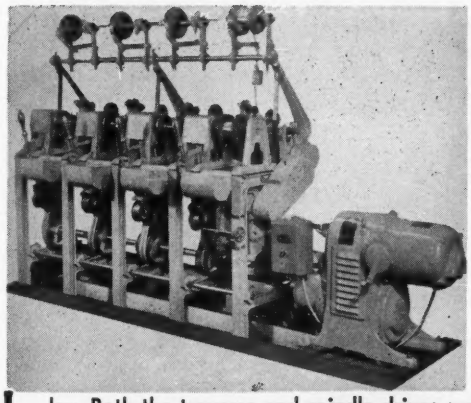

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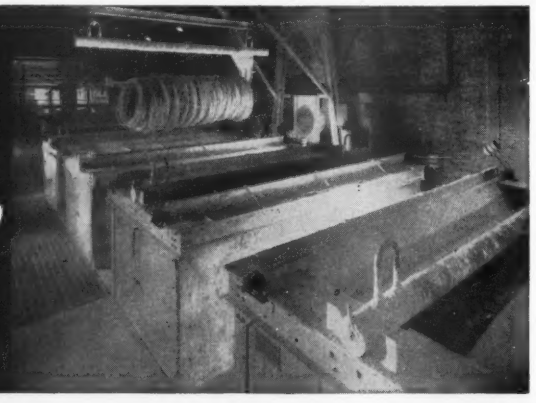

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feet per minute, depending upon alloy and gauge. Make-up lubricant is added as necessary.

★ ★ ★

The colloidal graphite cannot be detected on this drawn wire. The microscopic and sub-microscopic particles of graphite remain permanently suspended in the drawing compound and the dimensionless graphoid film produced on the die surface, as well as on the wire, furnishes superior lubrication and prolongs die life far beyond normal expectation.

★ ★ ★

As the need for improved lubrication continues to increase in all types of metal forming, colloidal graphite can contribute its unique combination of properties to assure successful operations. Ease of application, chemical stability, high lubricating value, reduced metal pickup, longer tool or die life—these are only a few of the many advantages provided by this versatile and valuable material.

Author's Note

'dag', 'Aquadag', 'Oildag' and 'Prodag'. are registered trademarks of Acheson Industries, Inc.

Important Technical Advances Made in Heat Treating of Wire in '55

(*Continued from page* 202)

trouble; they simply hadn't the capacity to handle the volume of gas being put through them.

★ ★ ★

With the problem pinpointed, mill personnel simply cut back on generator output and increased reboiler heating capacity until the analyzer indicated about 0.05% CO_2. Decarb problems all but disappeared, rejects for ball bearing stock dropped to a reasonable level, and other jobs improved similarly. In fact with the CO_2 record as a guide, rejects were reduced to a point where the resultant savings paid for the analyzer in a very short time.

The Natural and Artificial Aging of Wire Jackets

(*Continued from page* 194)

ment tests, a cell was constructed for exposing plastic sheet and filament to controlled gaseous ionization, rich in ultraviolet energy. It consisted of two concentric glass cylinders fitted together by a ground-glass joint, as shown in Figure 10. The plastic sheet and filament were wrapped around the inner cylinder as shown. A salt-water solution inside the inner electrode was connected to the high-voltage terminal of an energizer, and a similar solution outside the outer electrode was connected to the low-voltage terminal of the energizer. When the cell was partially evacuated and a voltage applied to the cell, gaseous ionization occurred in the annular space between the cylinders. The current density was limited by the capacitance of the glass walls. This glow discharge was in intimate contact with the plastic mounted in the cell. By controlling the applied voltage, frequency, pressure and nature of the gas, and duration of the exposure, it was possible to subject the plastic to controlled ion bombardment. Gaseous reaction products could be measured by measuring changes in gas pressure with a manometer connected to the cell.

★ ★ ★

Most of the samples of nylon were dried before being mounted in the cell. In some tests, however, the nylon was conditioned at 50 per cent relative humidity, to provide a known moisture content during exposure to ion bombardment.

★ ★ ★

Three energizers were employed: (1) a 15,000-volt, 60-cycle transformer, (2) a 100-watt, 2-megacycle oscillator and power amplifier, including a tuned voltage-step-up output circuit, and (3) a 2-kw., 200-k.c.p.s. power source with a voltage-step-up transformer; this source was operated at 1-kv., 140-ma. input. The last source gave the best results, i.e., (1) much greater gas evolution and loss of weight of the exposed nylon samples, (2) greater surface erosion of the nylon, and (3) more pronounced odor

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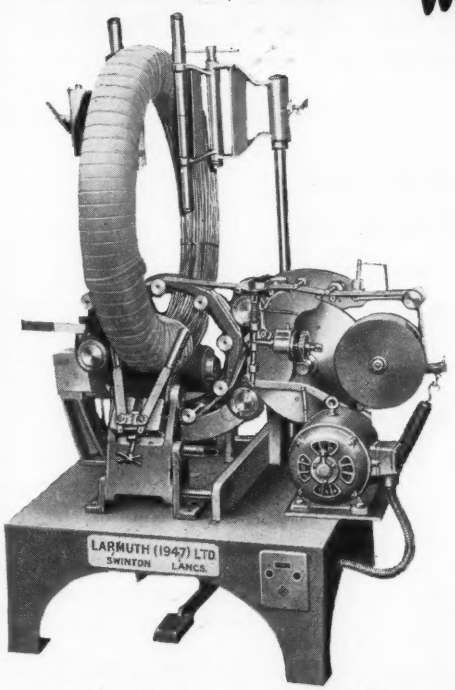

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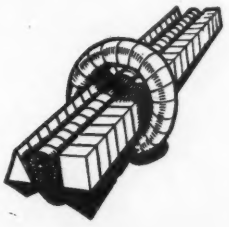

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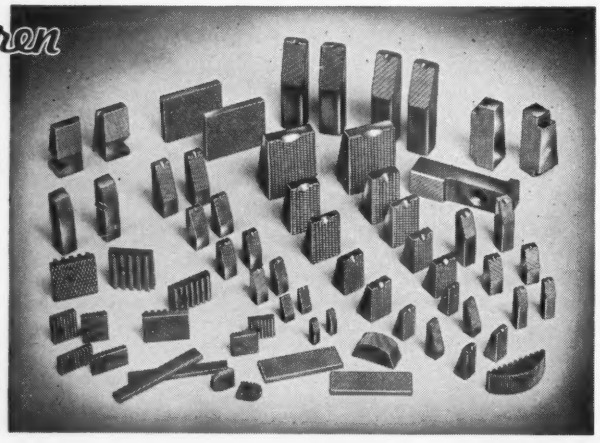

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of the evolved gas (acetamide for FM-3606 and "burnt rubber" for FM-7001).

* * *

Table 4 summarizes the results of the 200-k.c.p.s. ion-bombardment tests on all four types of nylon, both sheet and filament. All of these samples were dried before bombardment. Among the four nylons, there was practically no difference in total gas evolution, and not much difference in change in weight. No definite trend in the changes in electrical properties appeared to be evident. The decrease in conductivity of the FM-7001 nylon was probably due to loss of plasticizer during bombardment. The molecular weights became smaller for all nylons, and the extent of the decrease was surprisingly large. Perhaps the most important observation of all is that the tensile strength was higher after ion bombardment than before, for three of the nylons.

Conclusions

This study shows that the principal factors affecting the degradation of nylon are ultraviolet light and heat. It has also been shown that natural outdoor aging leads to embrittlement and loss of tensile strength. The principal effect of exposure to ultraviolet light is that of cleavage of the molecule, while heat initially causes cross linking with subsequent cleavage. Moisture, while important in the instantaneous physical properties of nylon, plays no important role in the degradation of the molecule.

* * *

The electrical tests on nylon sheets made under the conditions employed in this investigation are valuable in showing what happens in the nylon during exposure to various conditions of outdoor exposure and artificial aging. Information has been obtained on the leaching out of impurities under certain aging conditions and the production of ionizable reaction products under other aging conditions. The extreme avidity of the nylons for moisture has been emphasized by some of the observa-

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The Standard of the Wire Industry

tions made during the investigation. Experimental techniques have been developed which are of value in the electrical testing of plastic films in general.

★ ★ ★

X-irradiation of nylon in the presence of air and moisture is a promising method for producing accelerated degradation similar to that caused by weathering. The weakness of FM-7001 nylon is made apparent, and the nature of the changes in the materials is similar to that observed after exposure in Arizona. The use of X-irradiation in combination with a heat and moisture-condensation test might lead to still more promising results.

★ ★ ★

The ion-bombardment tests, although performed under several conditions, do not appear to show promise as an accelerated method to simulate natural weathering of nylon. In any further work in this direction, effort should be made to incorporate higher contents of oxygen and moisture in the test conditions. The use of glow discharges to increase the tensile strength of nylon is worthy of further investigation.

★ ★ ★

In the case of the other plastic samples, it is seen that these materials are very much more resistant to weathering than nylon, with the exception of the perbunan-vinyl compound. This material failed the mandrel-wrap test after 6 to 9 months' exposure.

★ ★ ★

No accelerated testing studies were carried out on these materials, since naturally aged samples did not fail the mandrel-wrap test during the time of this work, with the exception of the perbunan-vinyl compound.

Acknowledgments

The cooperation and support of R. G. Heiligmann, W. C. Ellis, Jr., and M. M. Baldwin, Chiefs of the divisions in which this work was done, are acknowledged. Most of the physical testing was done by R. E. Beck. A. B. Callahan, H. A. Magee, and J. A. Howard carried out the electrical studies.

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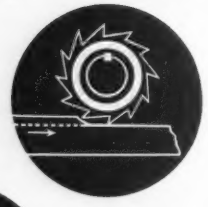
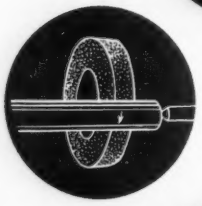
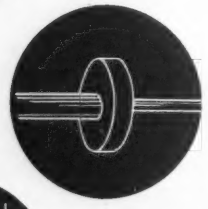


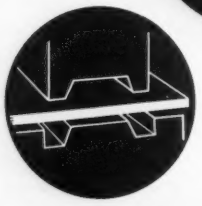
MILLING



GRINDING



DRAWING



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Rapid Test for Checking Pickling Rinse Waters

(*Continued from page* 200)

value is the maximum limit specified by the Navy (1) for combined concentration of iron (ferrous) sulfate and sulfuric acid impurities in pickling rinse waters.

Procedure

To 5 ml of the cooled rinse water are added 3 drops of O-phenanthroline ferrous complex indicator and 5 ml of ceric sulfate solution in I N sulfuric acid. Below 1.75 grams per gallon the color obtained is bright blue, indicating that the rinse water is usable and that the fresh water flow may be slowed down; above 1.75 the color is bright red, indicating excessive impurities. (The concentration of ceric sulfate is such that 5 ml will stoichiometrically oxidize the ferrous ion present in three drops of the indicator plus the ferrous ion present in 5 ml of a rinse water containing 1.75 grams of ferrous sulfate per gallon.)

★ ★ ★

A comparison of tests conducted by pickling-tank personnel employing the proposed method, with laboratory analyses are presented in Table 1. The results show that in all but two instances, the method had been useful for indicating whether the level of impurities was above or below the Navy limit of 2.0 grams per gallon.

★ ★ ★

The proposed method has been instrumental in maintaining a low level of impurities in the New York Naval Shipyard rinse water tanks, with consequent improvement of pickled steel surfaces.

★ ★ ★

Modifications of the proposed method, for hydrochloric acid pickling or for other ferrous sulfate limits are easily feasible.

(1) General Spec'n for Bldg. Vessels of the U. S. Navy; Appendix 6 of 2 Nov. 1951, with Amnd 2 of 13 May 1953.

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News from Abroad

A wire mill in Karabuk, Turkey, closed down in 1948, is again in operation, with an annual output of 2,000 tons of steel wire of 2, 3, 4, 6 and 8 mm. diameter.

★ ★ ★

In a current contract between France and Portugal running until March 31, 1956, the French have agreed to deliver forty million francs worth of electric cable of types not made in Portugal, and 100,000 francs worth of ACSR cable, the latter destined for Portuguese colonies.

★ ★ ★

The German wire industry, presently busy, giving employment to more than 40,000 persons, is playing an important part in the German economy. At the top of all the consumers of rolling-mill output, it takes about 11% of the total production.

★ ★ ★

The hardness and strength of copper, achieved by special processes in Germany, have made it possible to manufacture both tension and compression springs of this metal. In the recent Industrial Exposition in Berlin, the resistance to corrosion, the easy working and the high conductivity of this product were demonstrated.

★ ★ ★

Among the exhibits of cable and telephone equipment makers at the exposition were a model of a broadcasting installation, power cable, low voltage cable, insulated jumper wire and switch cordons for communications stations, etc., synthetic cable, varnished wire, wire baskets for self-service stores, a fish-cleaning apparatus, and such other common products as needles, paper clips, conduit wire, etc.

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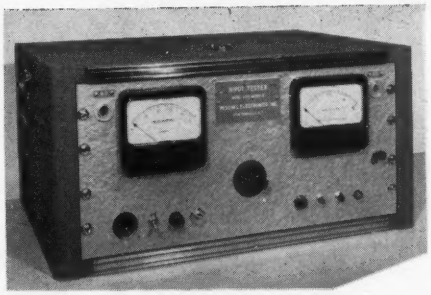

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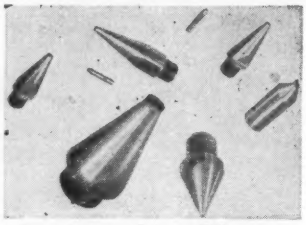

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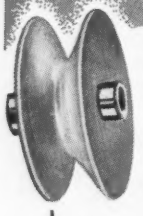

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New Invention of Adjustable Wire Brushes

Max Siebert, Celle, has invented and is producing adjustable wire brushes that will probably have further applications. The steel wires used in this wire brush are soldered to a tin-plate strip. The firmly soldered wires are held by two angle-irons and three stud-bolts. On both sides are found a threaded fork and wheel. By means of this attachment the brush can be adjusted at will. The two welded iron rods with a pipe and a post serve to bring the brush forward or backward. The apparatus comprises two angle irons, tin-plate strip with steel wires, two iron rods, a pipe, two wheels, two wing-nuts, a wooden post, three stud-bolts with nuts, two threaded forks and a wood-screw. The brush can be put to various uses. It is useful for sweeping leaves from the street, or as a rake. It is easy to operate because it runs on wheels. And it should have a long working life.

(From Draht-Welt, Nov. 10, 1955.)

Wire Drawing Lubricants

(*Continued from page* 196)

bath:

1. the preliminary or pickle bath which is followed by the first draft, and
2. the grease or finished drawing bath for all following drafts.

★ ★ ★

For the first: to about 100 liters of water add about 10 liters of sulphuric acid of specific gravity 60° Baumé and 1.5 kilos of copper sulphate. The pickling bath must always be kept clean. At perceptible abatement of its activity, normally after about 24 hours of use, it should be reconcentrated with 2 to 2.5 kilos of acid. Copper sulphate in smaller quantity is added. On the ground of cleanliness it is not wise to reconcentrate the bath too often. It should be made up afresh.

★ ★ ★

For the second: To 100 liters of water add about 1.5 kg of sulphuric acid at 60° Bé, 2 kg of copper sulphate and water-soluble draw-

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A new book by Anton Pomp, Dr. Eng. translated from German into English by C. P. Bernhoeft, Dipl. Eng., and published by The Wire Industry, London, Eng. It contains 358 pages of text and sells for $11.80 per copy.

It is the most up-to-date treatise on steel-wire manufacture available and covers the latest developments in wire processing, such as mechanical descaling, increased drawing speeds and lubricants for these high speeds, die shapes and modern testing procedures. The entire range of wire manufacture, from rods to finished products are discussed.

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ing compound according to need up to 3 kg.

★ ★ ★

The wire should show a continuously uniform red surface. Also here the bath should be reconcentrated after about 16 to 20 hours of use. For this, about ½ kg of acid should be added, Later also, water-soluble compound and copper sulphate. Also for this bath the advice given for the first bath holds; in order to assure a perfect appearance and satisfactory drawing. Too great a quantity of acid is in all cases to be avoided. It should be understood that a fully exact recipe is almost impossible. It must remain always subject to the experience and feeling of the wire drawer. The acid concentration will diminish with every additional draft, to such an extent that the finishing draft becomes acid-free.

Non-Ferrous Wire

For copper of larger diameter, lubrication of draft with compounds is favored. For brass of the same sizes, however, soap. For smaller sizes of both metals wet drawing is indicated. But also, especially for very fine wire, soluble oil containing an emulsifying and stabilizing agent or composite mineral oil and fats and fatty acids. No more fatty acid should be incorporated in the lubricant than is necessary, because otherwise spots appear on the bright metal.

★ ★ ★

Aluminum is less frequently drawn wet, because the metal is subject to the formation of spots. Mostly pure mineral oil is used for the drawing of the smaller sizes. In the drawing of larger diameters in rough draft or with lower velocities, use is made of a compound of mineral oil and fats and fatty acids, or so-called textile thread grease.

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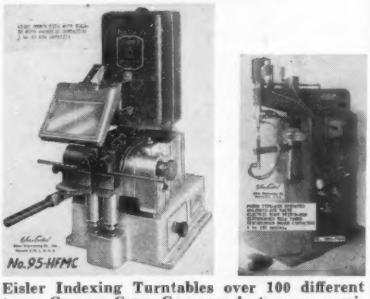

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Manufacture of Aluminum Conductor Telephone Cable

(*Continued from page* 182)

were the main contributors to the defects associated with welding. Another development to improve welding was made in the equipment itself. Our investigation disclosed that it was desirable to push the abutted wire ends together with a pre-weld pressure higher than that required for the welding operation to eliminate the high pre-weld resistance. This device is only in operation before the weld and is disengaged once the welding is started. We noted some improvement due to this device and they are currently installed on all of our capacitance type welders. The status of our welder development has reached a point where we are currently experiencing an average of 0.5 opens per million conductor feet due to welding at the twister check point as compared to 0.1 with copper.

★ ★ ★

Concurrent with the work done at Kearny on the condenser type welder, Kearny, Hawthorne and the Aluminum companies were jointly investigating the use of the well-known cold pressure type welding technique. Using this method the wire ends are securely gripped in a hand tool and butted together under high pressure. The resulting joint is excellent in that the weld is free of flash and does not have a greatly increased wire diameter which would act as a mechanical notch when running over sheaves. In addition, since there was no heat required to make the weld, the adjacent wire has not been annealed and in fact receives some work hardening. These two conditions are contrary to those introduced by resistance welding and have shown improved welding results during the subsequent operations. Kearny and Hawthorne are actively investigating pressure welding and both have experienced encouraging results during trials at the pulp insulating machine and high speed twisters on 20 and 22 gage. Hawthorne's original efforts were directed toward a redesign of the conventional tool which has proved superior to the modified conventional tool originally tried at Kearny. Kearny

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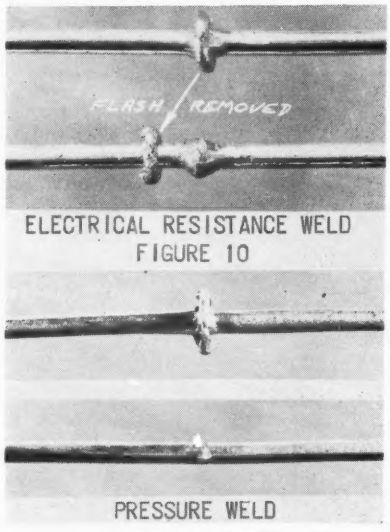
has since built a tool following the Hawthorne design and was able to duplicate the encouraging results obtained at the Chicago works. Each of the plants have purchased a commercial pressure welding tool for use on 17 gage aluminum. We are continuing our development efforts along this line and we probably will use this method of welding if our subsequent tests prove as satisfactory as the ones made to date. Photographs of condenser discharge and cold pressure type welds are shown in Figure 10. The problems asso-



ciated with the welding of aluminum conductors are confined to the manufacturing processes since all field splicing is done with a compression type connector.

Production Status

Before a high level of production was started the critical copper shortage eased and the incentive to increase the production of aluminum conductor cable was relaxed. It was, therefore, agreed that a production level of 70 million conductor feet a week, equally allocated to Kearny and Hawthorne, would be maintained to enable the continuation of manufacturing development work and gain experience with field installation and utilization problems. The distribution of gage sizes for this development program was 20 MCF of 20 gage, 10 MCF of 22 gage and 5 MCF of 17 gage conductor at each plant. Two experimental cables were

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made containing 24 gage wire and the remainder of the development work on this size was deferred. A table of our production activities for the last thirty months is shown below:

	Thousand Linear Ft. of Cable	Million Conductor Feet
17 Gage	9,305	981
20 Gage	9,004	1,919
22 Gage	6,777	3,343
TOTAL	25,086	6,243

★ ★ ★

The development of manufacturing methods and facilities for aluminum conductor exchange area cable has been carried to the point where the problems of manufacture, except for conductor joining, are reasonably well resolved. Since enough aluminum conductor cable has been produced to implement a very wide scale study of its field performance, it has been decided to discontinue manufacture and allow field experience to accumulate. We feel that if field experience is satisfactory, aluminum conductor cable can be brought into production on short notice should copper become unavailable or other conditions make such a move desirable.

To Head Physics Dept. for Continental Can

Dr. Paul Erlandson, former chairman of the physics department and assistant vice president of Southwest Research Institute, San Antonio, Texas, has been named director of the department of physics of **Continental Can Company's** new Central Research and Engineering Division, according to **Curtis E. Maier,** general manager of the division, which will ultimately employ 75 professional scientists and 25 administrative personnel.

★ ★ ★

In his new position, Dr. Erlandson will head the company's experimental work on the application of the principles of physics to the high speed automatic equipment used in manufacturing and closing metal, paper, plastic and composite containers and closures, as well as to its future ionizing radiation sterilization program.

Fracture Studies in America 10,000 Years Ago

(*Continued from page* 176)

to 14,000 B.C.; and there is even a claim, though disputed, for a find of tools and fossils near Frederick, Oklahoma, having an age estimated at three-quarters of a million years.

★ ★ ★

In 1935, a group of Boy Scouts discovered some prehistoric artifacts in a cave in the Sandia Mountains east of Albuquerque, New Mexico. Lying within clearly separated strata, even the specimens of the middle stratum were of Folsom type, associated not only with the bones of mammoth and bison, but also the bones of the giant sloth and the camel. Figure 9 is a diagrammatic cross-section of the Sandia Site, the age of the artifacts in the lowest stratum being a subject of current investigation, with dates of the order of 20,000 B.C. being indicated.

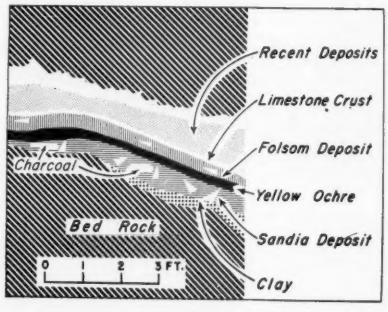

Figure 9
Schematic section of the Sandia Cave Site. The indicated stratigraphic relationships show Sandia artefacts within a stratum underlying the remains of a Folsom culture, hence having an age of at least 10,000 years, and probably of the order of 20,000 years. (Redrawn from Roberts in the "Scientific American".) * * * * *

Conclusion

Just as this discussion opened with a quotation from Branegan's interesting work, it can also be profitably closed with his description of an Indian flint works. He found that these Neolithic technologists first prospected for a suitable quarry or bed of quartz, chert, jasper, or argillite. After removing the topsoil from the rock, they built a huge fire, then threw cold water on the heated stone to cause fragmentation. The pieces were roughly shaped at the quarry by hammering and were then trans-

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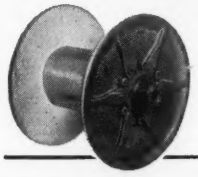

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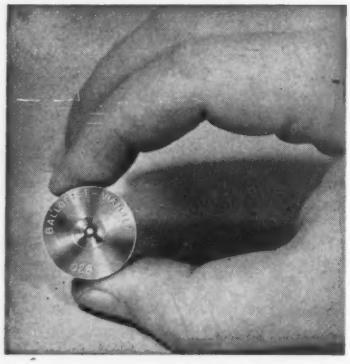

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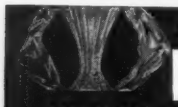

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ported to the village where they were *buried* to retain good fractological characteristics. This at once discloses a knowledge of fracture both by percussion and by thermal change; and it is particularly interesting to learn that the American Indian was so sensitive to fracture controls that he kept the flints underground to retain their moisture until time for flaking. The same careful treatment was shown for his processing of the bone used in pressure flaking. A suitable fragment was buried in hot ashes which were then moistened with water for purposes of degreasing, since it is a high secret of pressure flaking to have a clean and dry bone which will not slip. The Indian was accordingly producing a caustic alkali, and was removing the bone grease by saponification — to use modern terminology — thus anticipating the present soap technology. His knowledge also extended to matters of selection of materials, flint not being used for axes or tomahawks for the very reason of its sensitivity to flaking. These were made instead from water-worn pebbles of diorite, basalt, cryptocrystalline sandstones, hard hematite, and so forth.

★ ★ ★

As for his flint instruments, these even included a large spade which has been found in some numbers along the Mississippi River from St. Louis to the Gulf of Mexico.

Acknowledgment

Acknowledgment is due the Office of Naval Research for their sponsorship of a study of fracture from which much of the present material was taken; also to Mr. M. Haslem of Sioux Falls, South Dakota, who supplied the relics; to Mrs. Lloyd Harrison of Baltimore, Maryland, who aided in their study; and to Dr. F. H. H. Roberts of the Smithsonian Institution, who kindly supplied the photograph of the Folsom find.

National Electrical Week

About the time this magazine reaches its readers, "National Electrical Week" will have been observed throughout the country.

★ ★ ★

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★ ★ ★

Participating in the promotion of the project were practically every trade association, local and national, embracing manufacturers of electrical wire and cable, electrical appliances, distributors, dealers, contractors, inspectors and so on. Magazine and newspaper publicity, radio and T.V. announcements and other means of promotion bolstered interest in adequate wiring, all to the end that the builder and house owner equip homes with wiring capable of carrying the electrical loads of today.

★ ★ ★

It is hoped that the week's activities will initiate a public response to the need of proper wiring, both for safety and expanded use of electrical appliances.

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The idea of The National Electrical Week was first conceived by the International Association of Electrical Inspectors and it will hereafter be observed annually by

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★ ★ ★

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Henry C. Parker

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Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Dept. of General Electric Co., Detroit.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y
Vascoloy-Ramet Corp., Waukegan, Ill.
Willey's Carbide Tool Co., Detroit, Michigan.

DRAW BENCHES—
(See MACHINERY—Draw Benches)

DRUMS—Wire Packaging
Continental Can Company, Van Wert, Ohio

DRUMS & TRAVERSES—For Cable Reels
Hubbard Spool Co., Garrett, Ind.
New York Engineering Co., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio

DRYING EQUIPMENT
Carl Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio
Rockwell, W. S. Co., Fairfield, Conn.

ENGINEERS—Consulting
Lubricants—Hans C. Bick, Inc., Reading, Pa.
Wire Mill—Clarence S. Arms, Worcester, Mass.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

FURNACES—Brazing
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.

FURNACES—Galvanizing Equipment
Ajax Electric Co., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Heat Treating
Ajax Electric Co., Philadelphia, Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Drever Company, Bethayres, Pa.
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., Fairfield, Conn.
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.

FURNACES—Resistance Heating, Strand
(See Annealing Machines)

FURNACES—Salt Bath
Ajax Electric Co., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio
Rockwell, W. S. Co., Fairfield, Conn.

FURNACES—Strand Annealing
International Wire Products Corporation, Woodside Machinery Division, Midland Park, N. J.

GAUGES—Wire Diameter, Continuous
Industrial Gauges Corporation, West Englewood, N. J.

GALVANIZING EQUIPMENT — (See MACHINERY—Galvanizing Wire)

GRINDERS—Roll
Norton Co., The, Worchester, Mass.

GUIDES—For Wire
Heany Industrial Ceramic Corp., New Haven, Conn.

GUIDE TIPS—For Extruding Machines (See NOZZLES)

HAMMERS—Nail Heading
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

HAMMERS—Swaging
Sjogren Tool and Machine Co., Auburn, Mass.

HARDSURFACING ALLOYS—
(See Alloys—Hardsurfacing)

HOOKS—Pickling & Liming
Youngstown Welding & Eng'g' Co., Youngstown, Ohio

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

INHIBITORS—Pickling
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

INSULATING MATERIALS—
Celanese Corporation of America, New York, N. Y.
Chemical Products Co., E. Providence, R. I.
Electronic Rubber Co., Stamford, Conn.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Naugatuck Chemical Div., U. S. Rubber Co., New York, N. Y.
Pittsburgh Plate Glass Company, Pittsburgh, Pa.
Plymouth Cordage Company, Plymouth, Mass.

INSULATING MATERIALS—Paper (For Electric Wire Cable)
Plymouth Cordage Company, Plymouth, Mass.

LACQUERING SYSTEMS — See MACH.—Lacquering Electric Wire

LACQUERS—For Electric Wire
Chemical Products Co., E. Providence, R. I.

LAGGING—Reel
North Anson Reel Co., No. Anson, Me.

LAME—LAHN—
Montgomery Co., The, Windsor Locks, Conn.

LIME—
Warner Co., The, Philadelphia and Bellefonte, Pa.

LUBRICANTS — For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N. Y.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison, N. J.
Rome Soap Mfg. Co., Rome, N. Y.
Standard Industrial Compounds Co., Chicago.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUBRICANTS—Wire Rope
Swift & Co., Chicago, Ill.
Ironsides Co., The, Columbus, Ohio

LUBRICANTS—for Metal Cutting, etc.
Ironsides Co., The, Columbus, Ohio

MACHINERY—Armoring (Cable, Wire, Hose)
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Barbed Wire
Glader Wm., Machine Works, Chicago, Ill.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Bending Wire
Eisler Engineering Co., Newark, N. J.

MACHINERY—Bobbin Winders
Cedar West Tool Inc., New York, N. Y.
Mummert-Dixon Company, Hanover, Pa.
Wire Equipment Mfg. Co., Trenton, N. J.

MACHINERY—Braiding
New England Butt Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bunching
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Providence, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Haskell-Dawes Machine Co Philadelphia, Pa.
New England Butt Co., Providence, R. I.
New York Engineering Co., Yonkers, N. Y.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Capstans (See Machinery—Winding Wire)

MACHINERY—Centerless Grinding
Schumag Schumacher Metallwerke, Aachen, Germany.

MACHINERY—Chain Making
Nilson, A. H. Machine Co., Bridgeport, Conn.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Closing Rope
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

MACHINERY—Coiling Rod
Vaughn Mach'y Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Cold Heading
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Coil Wrapping (Paper)
Angier Corporation, Framingham, Mass.

MACHINERY—Copper Wire Drawing
American Insulating Mach'y Co., Phila., Pa.
National Mach'y Exch. (Used), New York.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire (See MACHINERY—Insulating Wire)

MACHINERY—Cutting
Eisler Engineering Co., Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.
Wells, Frank L., Co., Kenosha, Wis.

MACHINERY—Descaling Rod, Dry
Fisher Associates, New York, N. Y.
Herborn, Herborn, Germany.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

MACHINERY—Die Making
Boulin, Victor J., Inc., New York, N. Y.
Carboloy Dept. General Electric Co., Detroit, Mich.
Dykrex Corp., Roos Tool & Mfg. Div., Newark, N. J.
Firth Sterling, Inc., Pittsburgh, Pa.
Union Wire Die Corporation, New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

MACHINERY—Draw Benches
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Edging (See MACHINERY — Tandem Rolling and Edging Mills)

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio.
Rockwell Co., W. S., Fairfield, Conn.

MACHINERY—Extruding
Davis-Standard Sales Corp., Mystic, Conn.
Royle, John, & Sons, Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.

MACHINERY—Flat Wire
Fenn Manufacturing Co., Newington, Conn.
Mettler Machine Tool, Inc., New Haven, Conn.
Rockwell, W. S., Company, Fairfield, Conn.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Forming Wire
Baird Machine Co., Stratford, Conn.
Nilson, A. H., Machine Co., Bridgeport, Conn.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Galvanizing Wire
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Gang Winders
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating Wire
American Insulating Mach'y Co., Phila., Pa.
Davis-Standard Sales Corp., Mystic, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio.
New England Butt Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lacquering Electric Wire
American Insulating Mach'y Co., Philadelphia.
Cook Mfg. Co., The, Paterson, N. J.
Industrial Ovens, Inc., Cleveland, O.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Looms, Wire Weaving
Cedar West Tool Inc., New York, N. Y.
Mummert-Dixon Co., Hanover, Pa.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Material Handling
(See Material Handling Equipment)

MACHINERY—Measuring Wire & Cable
Davis Electric Company, Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wis.
New England Butt Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Baird Machine Co., The Stratford, Conn.
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N. Y.
Seybold Transworld Exporters, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Packaging Wire
Coulter & McKenzie Machine Co., Bridgeport, Conn.

MACHINERY—Pickling
Youngstown Welding & Eng'g Co., Youngstown, Ohio.

MACHINERY—Pin Making
Baird Machine Co., The, Stratford, Conn.

MACHINERY—Plating
Universal Industrial Equipment Co., Secaucus, N. J.

MACHINERY—Pointing
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury Conn.

MACHINERY—Pumps for Molten Metal
Wire Equipment Mfg. Co., Trenton, N. J.

MACHINERY—Re-Spooling
Davis Electric Company, Wallingford, Conn.
Emory, Robert J., Co., Newark, N. J.
International Wire Products Corp., Woodside Machinery Division, Midland Park, N. J.
Mummert-Dixon Co., Hanover, Pa.
National Mach'y Exch. (Used), New York.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.
Wire Equipment Mfg. Co., Trenton, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Rod Mill
Fenn Manufacturing Co., Newington, Conn.
Morgan Construction Co., Worcester, Mass.
Schumag Schumacher Metallwerke, Aachen, Germany

MACHINERY—Rolling Mill
Fenn Manufacturing Co., Newington, Conn.
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Insulating
Davis-Standard Sales Corp., Mystic, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio.
Royle, John & Sons, Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Serving
Pourtier Pere et Fils, Romainville (Seine), France
Wardwell Braiding Machine Co., Central Falls, R. I.

MACHINERY—Spark Testing
Davis Electric Company, Wallingford, Conn.
Peschel Electronics, Inc., New Rochelle, N. Y.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany
Wells, Frank L., Co., Kenosha, Wisc.

MACHINERY—Staple
Nilson, A. H. Machine Co., Bridgeport, Conn.
Seybold Transworld Exporters, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Straightening & Cutting
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Wells, Frank L., Co., Kenosha, Wisc.

MACHINERY—Stranding
Haskell-Dawes Machine Co., Philadelphia, Pa.
Milton Machine Works, Inc., Milton, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Swaging
Fenn Manufacturing Co., Newington, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Take-Up and Pay-Out
American Insulating Mach'y Co., Phila., Pa.
Davis Electric Company, Wallingford, Conn.
Davis-Standard Sales Corp., Mystic, Conn.
Fenn Manufacturing Co., Newington, Conn.
Industrial Ovens, Inc., Cleveland, Ohio
International Wire Products Corporation, Woodside Machinery Division, Midland Park, N. J.
Litzler, C. A., Co., Inc., Cleveland, Ohio.
New York Engineering Co., Yonkers, N. Y.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.
Wire Equipment Mfg. Co., Trenton, N. J.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Testing Magnet Wire Coatings for Pin Holes
Peschel Electronics, Inc., New Rochelle, N. Y.

MACHINERY—Testing, Physical
Scott Testers, Inc., Providence, R. I.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
International Wire Products Corporation, Woodside Machinery Division, Midland Park, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Universal Industrial Equipment Co., Secaucus, N. J.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill, Cold Drawing
Mettler Machine Tool, Inc., New Haven, Conn.

MACHINERY—Turks Head
Fenn Manufacturing Co., Newington, Conn.

MACHINERY—Twinning
(See Mach.—Bunching)

MACHINERY—Twisters, Wire
Cook Manufacturing Co., The, Paterson, N. J.
Davis Electric Company, Wallingford, Conn.
Edmands Company, The, Providence, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.

MACHINERY—Used
National Machinery Exchange, New York, N. Y.
Wire & Textile Machy., Inc., Pawtucket, R. I.

MACHINERY—for Wire Welding
(See WELDERS—Butt and Spot)

MACHINERY—Winding Wire
Emory, Robert J., Newark, N. J.
Fenn Manufacturing Co., Newington, Conn.
Mummert-Dixon Co., Hanover, Pa.
New England Butt Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.
Wire Equipment Mfg. Co., Trenton, N. J.

MACHINERY—Wire Drawing
Cook Manufacturing Co., The, Paterson, N. J.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Fenn Manufacturing Co., Newington, Conn.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

Herborn, Herborn, Germany
International Wire Products Corporation, Woodside Machinery Division, Midland Park, N. J.
Morgan Construction Co., Worcester, Mass.
Morgardshammers Mek Verstads AB, Morgardshammer, Sweden
National Mach'y Exch. (Used), New York, N. Y.
Schumag Schumacher Metallwerke, Aachen, Germany
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, Ohio
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Wire Forming
Baird Machine Co., The, Stratford, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Wire Rope
Milton Machine Works, Inc., Milton, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

MACHINERY—Wrapping with Paper
Larmuth (1947) Ltd., Swinton, England
Terkelsen Machine Co., Boston, Mass.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

NAIL TOOLING—Tungsten Carbide
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

NAILS—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Brothers, Inc., Cortland, N. Y.

NIPPERS—Wire Cutting
Robinson, M. W. Co., Rockfall, Conn.

NOZZLES—For Extruding Machines
Wire Tool Div., Bridgeport Jig Boring Co., Bridgeport, Conn.

OVENS—Cable Lacquering and Enameling
American Insulating Mach'y Co., Phila., Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio.
Rockwell Co., W. S., Fairfield, Conn.

OVENS—Rod Bakers
Carl Mayer Corp., The, Cleveland, Ohio

OVENS—Welding Rod Coating
Carl Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio.

PAINT BONDING CHEMICALS—
American Chemical Paint Co., Ambler, Pa.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PAPER—Creped Wrapping
Angier Corporation, Framingham, Mass.
Arkell Safety Bag Company, New York, N. Y.
National Waterproof Papers, Inc., Beverly, N. J.
Terkelsen Machine Co., Boston, Mass.

PAPER—For Coil Wrapping and Corrosion Prevention
Angier Corporation, Framingham, Mass.
Arkell Safety Bag Company, New York, N. Y.
National Waterproof Papers, Inc., Beverly, N. J.
Terkelsen Machine Co., Boston, Mass.

PAPER—Insulating
Plymouth Cordage Company, Plymouth, Mass.

PATENT ATTORNEYS—
Lancaster, Allwine & Rommel, Washington, D. C.

PAY-OUT SYSTEMS—
(See MACHINERY—Take-Up & Pay-Out)

PHOSPHATE COATING CHEMICALS
(See COMPOUNDS—Phosphate Coating)

PICKLING COMPOUNDS—
See (Inhibitors—Pickling)

PICKLING—Hooks, etc. Acid Resisting
Youngstown Welding & Eng'g Co., Youngstown, Ohio

PICKLING TANK LININGS—
Chemsteel Construction Co., Inc., Pittsburgh, Pa.
Haveg Corp., Newark, Del.

PIPES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

PLASTICIZERS—
Celanese Corporation of America, New York, N. Y.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Naugatuck Chemical Div., U. S. Rubber Co., New York, N. Y.

PLASTICS—for Wire Insulation
Celanese Corporation of America, New York, N. Y.
Electronic Rubber Co., Stamford, Conn.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Naugatuck Chemical Div., U. S. Rubber Co., New York, N. Y.
U. S. Industrial Chemicals Company, Division of National Distillers Products Corporation, New York, N. Y.

POTS—Lacquer
Industrial Ovens, Inc., Cleveland, Ohio

PULLERS AND GRIPS—For Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, Ohio

PUMPS—Molten Metal
Fisher Associates, New York, N. Y.

REEL AND TENSION STANDS—
Davis Electric Company, Wallingford, Conn.
Industrial Ovens, Inc., Cleveland, Ohio.
New York Engineering Co., Yonkers, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Co., Garrett, Ind.
Milton Machine Works, Inc., Milton, Pa.
Muncy Valley Industries, Inc., Muncy Valley, Pa.
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Garrett, Ind.
Milton Machine Works, Inc., Milton, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Muncy Valley Industries, Inc., Muncy Valley, Pa.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio

REELS—Metal Round
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
North Anson Reel Co., No. Anson, Me.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

REELS—Plywood
Carris Reels, Inc., Rutland, Vt.
Hubbard Spool Co., Garrett, Ind.
Nelson Company, The, Baltimore, Md.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

REELS & SPOOLS—Steel (All Types)
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L. Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Garrett, Ind.
Mason Can Company, East Providence, R. I.
Milton Machine Works, Inc., Milton, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New York Engineering Co., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS—Wire Mill
American Pulley Co., Philadelphia, Pa.
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
Mason Can Company, East Providence, R. I.
Mettler Machine Tool, Inc., New Haven, Conn.
Milton Machine Works, Inc., Milton, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New York Engineering Co., Yonkers, N. Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
North Anson Reel Co., No. Anson, Me.
Republic Steel Corp., Pressed Steel Div., Niles, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Wood
American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
Muncy Valley Industries, Inc., Muncy Valley, Pa.
Nelson Company, The, Baltimore, Md.
North Anson Reel Co., No. Anson, Me.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

REFRACTORIES—High Temperature
Norton Company, Worcester, Mass.

ROD BAKERS—
(See OVENS—Rod Bakers)

RODS—Stainless Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Crucible Steel Co. of America, Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.

RODS—Wire—Non-Ferrous
Chase Brass & Copper Co., Waterbury, Conn.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Platt Bros. & Co., The, Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.
Titan Metal Manufacturing Co., Bellefonte, Pa.

RODS—Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Sheffield Steel Corp., Kansas City, Mo.
Youngstown Sheet & Tube Co., Youngstown, O.

ROPE—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J

RUST PROOF COMPOUNDS—
(See COMPOUNDS—Rust Preventing)

RUST REMOVING COMPOUNDS—
(See COMPOUNDS—Rust Preventing)

SATURATION SYSTEMS—
Industrial Ovens, Inc., Cleveland, Ohio
New York Engineering Co., Yonkers, N. Y.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

SOAPS—Industrial and Wire Drawing
(See COMPOUNDS—Wire Drawing)

SPOOLS—(See Reels & Spools)

SPOOLS—Stamped Metal for Retail Wire Sales
Clark, J. L. Mfg. Co., Rockford, Ill.
Mason Can Co., East Providence, R. I.

STAMPINGS—Steel
Acrometal Products, Inc., Minneapolis, Minn.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

TANKS—Compound
New York Engineering Co., Yonkers, N. Y.
Watson Machine Co., Paterson, N. J.

TANKS—Pickling and Plating
Chemsteel Construction Co., Inc., Pittsburgh, Pa.

TESTERS — INSULATION
(See MACHINERY—Spark Testers)

TESTING EQUIPMENT
(See MACHINERY Testing, Physical and Diameter Testing)

TINSEL—Electric Conductor
Montgomery Co., The, Windsor Locks, Conn.

TINSEL WIRE—Resistance, Lame, Decorative Cords Thread—Bare Copper, Silver and False Gold Coated, etc.
(See TINSEL—Electric Conductor)

TOOLS—Nail Machine
Pittsburgh Carbide Die Co., Monongahela, Pa.
Wire Equipment Mfg. Co., Trenton, N. J.

TOOLS—Wire Cutting
Porter, H. K. Inc., Somerville, Mass.

TOOLS—Spring Forming, Carbide
Crafts, Arthur A., Company, Inc., Boston, Mass.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TRANSMISSIONS—Variable speed (See Machy—Power Transmission)

TRAVERSES & DRUMS—For Reels
(See Drums & Traverses)

TRAVERSE MECHANISMS—
Apco Mossberg Co., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

VALVES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

VARNISHES & LACQUERS—for Electric Wire
Chemical Products Co., E. Providence, R. I.

VULCANIZING PANS AND EQUIPMENT—
American Insulating Mach'y Co., Phila., Pa.
Litzler, C. A., Co., Inc., Cleveland, Ohio.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.

WIRE—Aluminum
International Wire Products Corporation, Woodside Machinery Division, Midland Park, N. J.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Malin & Co., The, Cleveland, Ohio
National Standard Company, Niles, Mich.
Scovill Mfg. Co., Waterbury, Conn.

WIRE—Barbed
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

WIRE—Brass and Bronze
Chase Brass & Copper Co., Waterbury, Conn.
International Wire Products Corporation, Woodside Machinery Division, Midland Park, N. J.
Jury's Wire Products, Inc., Bloomfield, N. J.
Scovill Mfg. Co., Waterbury, Conn.
Titan Metal Manufacturing Co., Bellefonte, Pa.

WIRE—Bunched & Stranded, Copper
Camden Wire Co., Camden, N. Y.
International Wire Products Corporation, Woodside Machinery Division, Midland Park, N. J.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Cold Heading
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Camden Wire Co., Camden, N. Y.
Chase Brass & Copper Co., Waterbury, Conn.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind
Crucible Steel Co. of America, Pittsburgh, Pa.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Steel Corp., Kansas City, Mo.
Titan Metal Manufacturing Co., Bellefonte, Pa.
Wickwire Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Copper
Camden Wire Co., Inc., Camden, N. Y.
Chase Brass & Copper Co., Waterbury, Conn.
International Wire Products Corporation, Woodside Machinery Division, Midland Park, N. J.
Jury's Wire Products, Inc., Bloomfield, N. J.

WIRE—For Electrical Conductors
Camden Wire Co., Camden, N. Y.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.

WIRE—Flat, Fine
Montgomery Co., The, Windsor Locks, Conn.

WIRE—Galvanized
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
National Standard Company, Niles, Mich.
Roebling's, John A. Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Manufacturers
Alloy Metal Wire Div., H. K. Porter Company, Inc., Prospect Park, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Kaiser Aluminum & Chemical Corp., Oakland, Calif.
Keystone Steel & Wire Co., Peoria, Ill.
National Lock Washer Company, The, Newark, N. J.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Steel Corp., Kansas City, Mo.
Titan Metal Manufacturing Co., Bellefonte, Pa.
U. S. Steel Corp., N. Y., N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Music
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., The, Cleveland, Ohio

WIRE—Nickel Silver and Phosphor Bronze
Alloy Metal Wire Div., H. K. Porter Company, Inc., Prospect Park, Pa.
Chase Brass & Copper Co., Waterbury, Conn
International Wire Products Corporation, Woodside Machinery Division, Midland Park, N. J.
Malin & Co., The, Cleveland, Ohio
Titan Metal Manufacturing Co., Bellefonte, Pa.

WIRE—Oil Tempered
Crucible Steel Co. of America, Pittsburgh, Pa.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.

WIRE—Silver Plated Copper
Camden Wire Co., Camden, N. Y.
International Wire Products Corporation, Woodside Machinery Division, Midland Park, N. J.

WIRE—Special Shapes
Alloy Metal Wire Div., H. K. Porter Company, Inc., Prospect Park, Pa.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
National Lock Washer Company, The, Newark, N. J.
Titan Metal Manufacturing Co., Bellefonte, Pa.

WIRE—Spring
Alloy Metal Wire Div., H. K. Porter Company, Inc., Prospect Park, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O

WIRE—Stainless Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Crucible Steel Co. of America, Pittsburgh, Pa.
Firth Sterling, Inc., Pittsburgh, Pa.
International Wire Products Corporation, Woodside Machinery Division, Midland Park, N. J.
National Lock Washer Company, The, Newark, N. J.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.

WIRE—Steel—Also Coppered and Galvanized Steel
Alloy Metal Wire Div., H. K. Porter Company, Inc., Prospect Park, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Jury's Wire Products, Inc., Bloomfield, N. J.
Keystone Steel & Wire Co., Peoria, Ill.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O

WIRE—Straightening and Cutting
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Tinned Copper
Camden Wire Co., Camden, N. Y.
International Wire Products Corporation, Woodside Machinery Division, Midland Park, N. J.
Jury's Wire Products, Inc., Bloomfield, N. J.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WOOD—for Guide, Rolls, Bushings, Wear Parts, etc.

WRAPPING PAPER—Creped
(See PAPER—Creped Wrapping)

YARNS & TAPES—Insulating
Celanese Corporation of America, New York, N. Y.
Pittsburgh Plate Glass Company, Pittsburgh, Pa.

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

The WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON 3, NEW JERSEY, U. S. A.

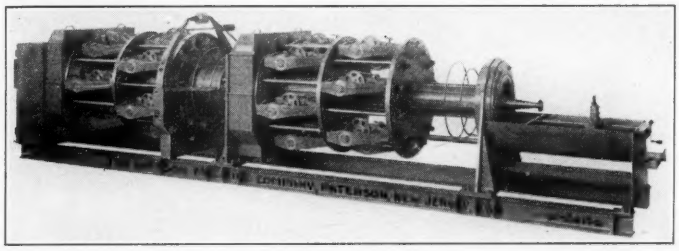
ELECTRICAL WIRE AND CABLE, WIRE ROPE, CORDAGE AND MASTICATING MACHINERY MANUFACTURERS

WATSON

STRANDING HEADS

PATENTS AND PATENTS PENDING

BACKED BY MANY YEARS OF EXPERIENCE AND CONSTANT EFFORT, WE OFFER SUPERIOR MACHINES WHICH MEET ALL REQUIREMENTS, OF WHICH THE FEW SHOWN HERE ARE EXAMPLES.

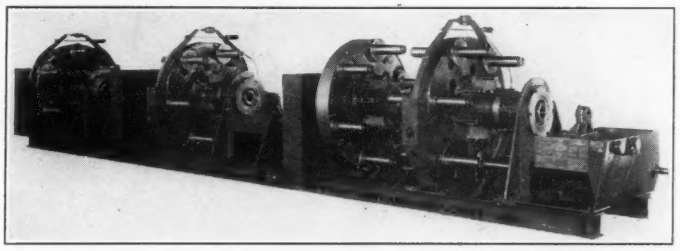


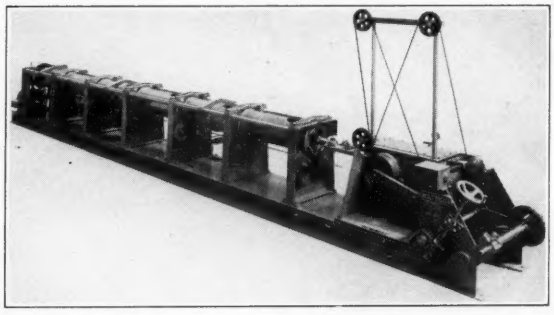
TYPE "PH/GB" SERIES 1500—PLANETARY

No. W-2414a. FOR 24-12" SPOOLS. "SHAFTLESS", INTEGRAL FRICTION, NO-LOOSE-PART CRADLES ELIMINATE SPOOL SLAP. VARIABLE GEARED BACKTURN. FOR HEAVIEST DUTY. COMPLETELY BALL BEARING. AVAILABLE IN 12 SIZES AND COMBINATIONS.

TYPE "RH"—RIGID FRAME

No. W-3933. 6, 12 and 18 SPOOL HEADS FOR 22" SPOOLS. MOUNTED ON COMMON BASE FOR 37 WIRE STRAND PRODUCTION IN ONE PASS AND TO 127 WIRE STRAND PRODUCTION BY MULTI-PASS. PRODUCES ROUND AND SECTOR, COPPER AND ALUMINUM STRANDS AT HIGHEST SPEED AND LOWEST COST. AVAILABLE IN 24 SIZES AND COMBINATIONS.



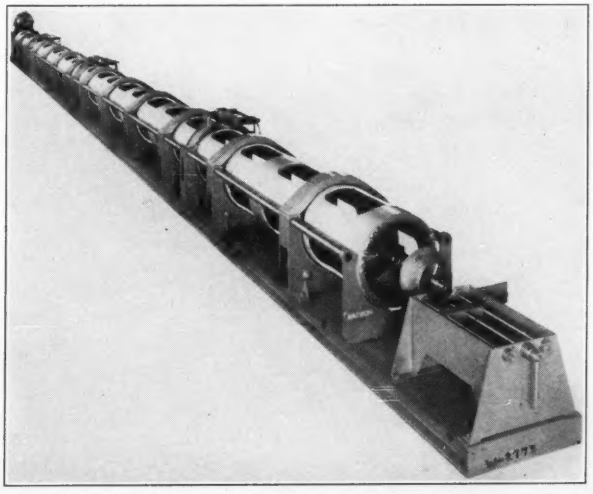


TYPE "VL"—EXTRA HIGH SPEED—TUBULAR

No. W-4144-46. COMPLETE 12—7" SPOOL MACHINE, 1800 R.P.M. "SHAFTLESS", NO-LOOSE-PART, AUTOMATIC LOCK CRADLES. HIGHEST PRODUCTION RECORDS. SAFE AND QUIET. AVAILABLE IN 24 SIZES AND COMBINATIONS.

TYPE "TH"—HIGH SPEED—TUBULAR

No. W-2773. 25—22" SPOOL HEAD, 435 R.P.M. SOLID BOX BASE. ONE-HAND SELF-LOCKING BOAT CRADLES. SINGLE SPIDERS. ALL STEEL ROTOR. AUTOMATIC SPRING SET BRAKES. THE INDUSTRY'S STANDARD FOR MANY YEARS. AVAILABLE IN 38 SIZES AND COMBINATIONS.



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Descriptive Literature Available on all Head Types and on Capstans, Takeups and Other Auxiliaries.

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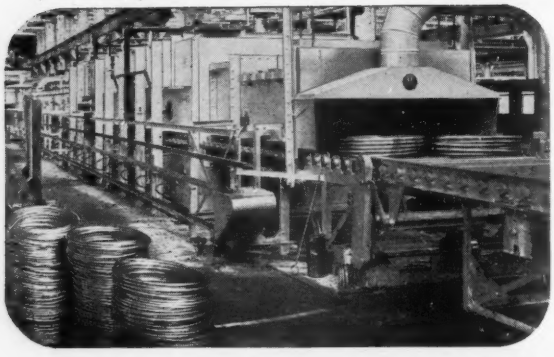
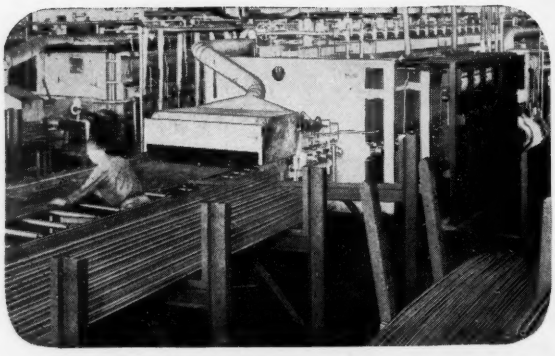
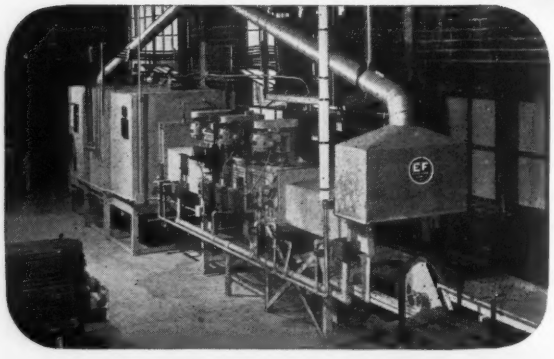


Straight lengths of brass and copper tubing are also bright and scale-free annealed in this EF gas fired furnace. Capacity 4000 lbs. per hour.



EF gas fired forced convection continuous roller hearth special atmosphere furnace bright annealing long straight lengths of tubing.

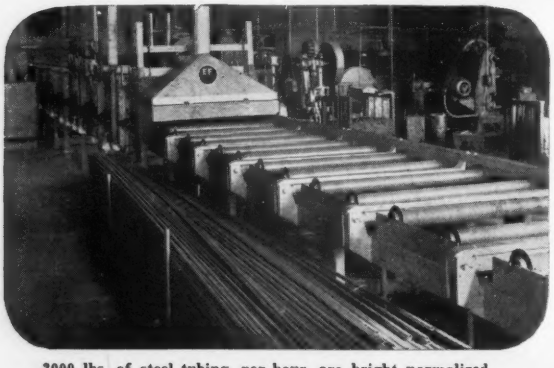
ANNEALING TUBING BRIGHT *and* CLEAN *Continuously*



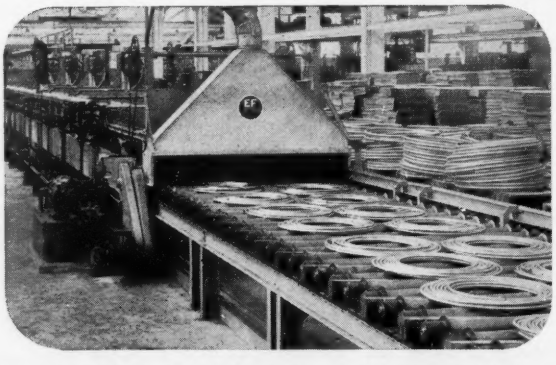
A special atmosphere belt conveyor electric furnace annealing short lengths of alloy tubing—operates at temperatures up to 2040° F.

We have built many outstanding production furnaces for processing copper, brass, stainless, aluminum, nickel silver and other ferrous and non-ferrous tubing—in large and small coils—straight lengths, long and short, and in various diameters—also for wire, strip, stampings and many other products and processes.

Put your production furnace problems up to experienced engineers — *it pays.*



3000 lbs. of steel tubing, per hour, are bright normalized in this EF gas fired radiant tube type special atmosphere furnace.



Straight lengths of tubing up to 5" in diameter and ¾" thick are also annealed in this EF forced circulation roller hearth furnace.

EF

Gas-Fired, Oil-Fired and Electric Furnaces

for any Process, Product or Production

THE ELECTRIC FURNACE CO.

WILSON ST. at PENNA. R. R. *Salem - Ohio*

Canadian Associates • CANEFCO LIMITED • Toronto 1, Canada